CONSTRAINTS ON THE ADOPTION OF ADAPTIVE WATER MANAGEMENT PRINCIPLES: THE CASE OF GREATER TEHRAN

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PHD

2014

CONSTRAINTS ON THE ADOPTION OF ADAPTIVE WATER MANAGEMENT PRINCIPLES: THE CASE OF GREATER TEHRAN

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Submitted for the Degree of
Doctor of Philosophy

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2014

Abstract

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Constraints on the adoption of Adaptive Water Management principles: the case of Greater Tehran

Keywords: Adaptive Water Management principles, polycentric governance, institutional flexibility, public participation, sustainability, Tehran water management

Continued water scarcity, flooding, pollution and urbanisation, especially in developing countries, have signified the necessity of renewed exploration of the most appropriate approach to water management. This approach should aim to meet the water requirements in the changing world in a sustainable way. Reviewing the different water approaches that have emerged in the developed countries during the last decades suggests that Adaptive Water Management (AWM) could provide a sustainable route to address the existing complex problems of urban water management through the future.

The purpose of this study was to determine whether AWM could be applied to Greater Tehran in order to maximise sustainability and deal with the future uncertainties. The AWM characteristics of polycentric governance, institutional flexibility, and public participation were used to assess the adaptability of the existing water management.

The research findings showed that, despite the lack of adaptability in the current Greater Tehran water management, there are positive attitudes towards adaptability among water professionals and the public. The research findings emphasised that the AWM application could be promoted by more participation in various levels of institutional structure. This thesis suggests that if the concept of AWM is applied to Iran, it has the potential to have a significant influence in the current/future water management by promoting technical and institutional performances simultaneously.

Acknowledgments

First of all, I would like to say my especial thanks to Liz Sharp for her effective supervision, continuing encouragement, skilful comments and suggestions, patience and support to keep me going throughout my study. And also many thanks to Tom Franks for his supervision, guidance comments and valuable support during my study.

Massive thanks to my husband, Reza and my children, Alireza and Mehrnoush for their constant encouragement, understanding, tolerance, love and support.

TO ALL OF YOU I SAY "THANK YOU"

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Glossary of Abbreviations

AWM .....Adaptive Water Management

IWRM ..... Integrate Water Resource Management

SEW Co..... Shout-East Water Company

TPWW Co..... Tehran Province Water and Wastewater Company

TWW Co..... Tehran Water and Wastewater Company

WDM .....Water Demand Management

WSM.....Water Supply Management

Chapter 1

Introduction

"I am concerned with the next generation. I'm talking about crisis; all our country's natural bodies of water have nearly dried. If the situation is not corrected, in 30 years, Iran will turn into a desert" (Ex-minister of Agriculture for Iran, Qanon Newspaper 2013).

Iran is among the countries with the highest loss of freshwater. During a seven-year period, the Middle East region lost freshwater equal to a volume of 1.44×10^{11} m^3 (Voss et al 2013, NASA Report 2013). In Figure 1.1 the thick black line with hashed fill shows the area in the Middle East region including Iran with a strong negative trend in total water storage from January 2003 to December 2009 (Voss et al 2013). According to Voss et al (2013) water storage in the Middle East region is showing a decline after the beginning of a regional drought in 2007 and following changes in water use. It is mentioned that in a drought situation, farmers and people turn to groundwater use and consequently the majority of the water losses is due to reduction in groundwater availability caused by human activities (NASA Report 2013, Voss et al 2013). The constant drought in Iran is making the future water supply of the country uncertain. If the current water situation is continued, the country will lose more of its freshwater. As stated by Rahnemaei et al (2013) there is a high possibility that Iran will run out of suitable sites for dam construction in the near future.

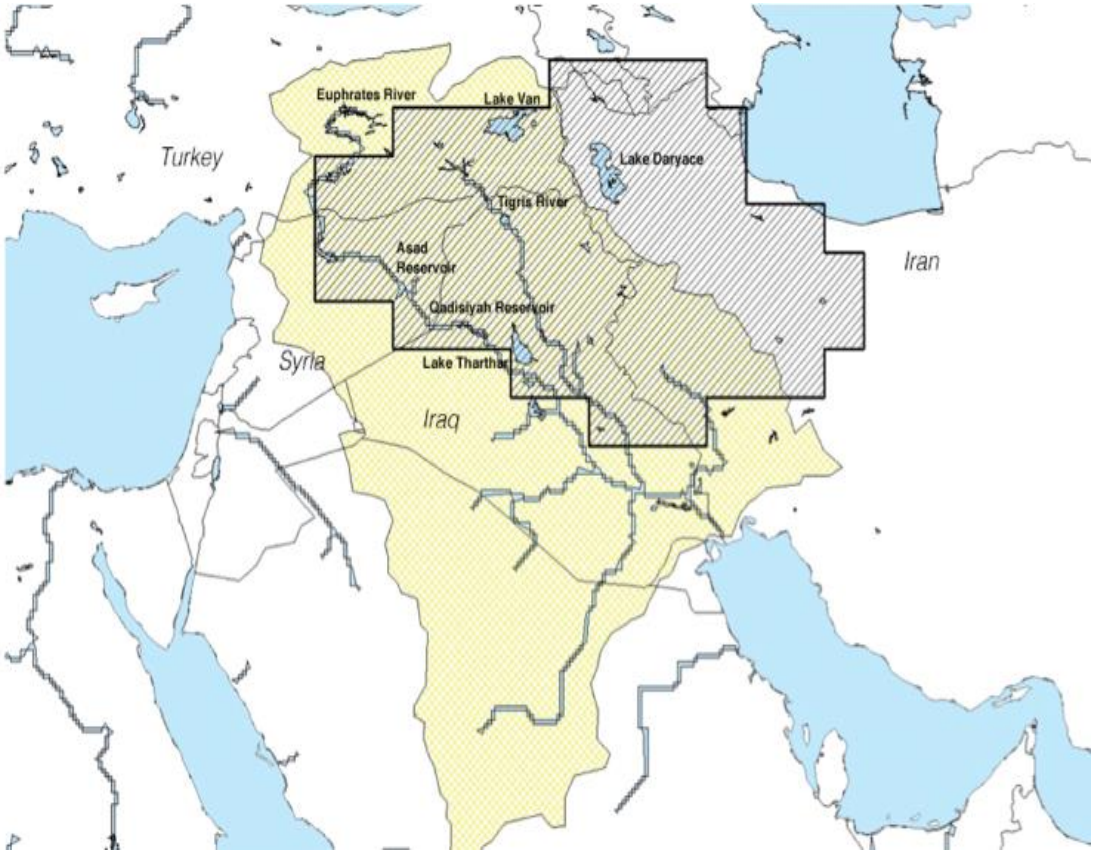

Figure 1.1 Iran among countries with major water losses

(Voss et al 2013)

Over the last century, Iran has experienced different water management approaches. Iran's water management could be historically verified as three stages. The first stage lasted until the 1920s, and can be characterised as local and practical water management. The second stage positioned from the early 1920 to 1980 and the focus was directed towards modern water management. This stage featured population increase, urbanisation and the domination of technical water management. More water supplies and construction were the results of the domination of the technical side of water management during this stage. The third stage started since 1980 by seeing

the necessity of reform in political and social systems in water management (Jahani and Reyhani 2006, Ardakanian 2005). This brief history highlighted an extreme change in water management during the last century. Water management of Iran has moved from practical water management of the communities in the early 20th century towards national and centralised water management with domination of the technical side of management in the 21th century. Despite the water management changes in the last decades it seems that the current water management is not suitable to secure current and future water sustainability in Iran, especially as the country is facing a water crisis of constant drought. As stated by Mahdani-Larijani (2005), there are no effective strategies to overcome the water related challenges in Iran. He added that this shortcoming is because of the domination of Water Supply Management (WSM) in the country. WSM mostly relies on a hard infrastructure (e.g. building dams) and focuses on technical solutions and supply development (Pahl-Wostl et al 2008). In WSM, each sector of domestic use, agriculture, industry and environmental protection has been managed separately, with limited coordination between them. This leads to a fragmented and uncoordinated development of water resources (Xie 2006). There has been an increased awareness that the current urban water management approaches such as WSM are not capable of facing the future water uncertainties in a sustainable way (Pahl-Wostl 2007, Brooks and Brandes 2011). As mentioned by Vitousek et al (1997) we live on a human dominated planet and human activities are causing rapid and substantial changes to the Earth's ecosystems; this means for the unexpected future conditions, there is a need for dynamic management approaches. In this

context, a new concept of Adaptive Water Management (AWM) is emerging for meeting the water management requirements in the changing world. Despite a few focused research works on AWM, there is a growing body of urban water management scholars who are focusing on moving towards AWM.

1.1. Adaptive Water Management (AWM)

While there has been no widely accepted definition of AWM within the literature, it has been recognised among the water academics that AWM could be a way for reaching the desirable goal of sustainable water management (Pahl-Wostl et al 2007, Keath and Brown 2009). Considering the true complexity of water systems, water management needs to move from technical management to a true integration of the human aspect, in which management becomes more adaptive to the rapid changing conditions (Pahl-Wostl 2007). The concept of AWM offers an alternative to the current urban water management approaches by providing insights into some of the governance factors in order to support more sustainable practices (Keath and Brown 2009). Von Korff et al (2012) highlighted that the concept of adaptive management is closely linked to the concept of social learning, underlining collaboration and the development of shared practices between various organisations involved in water sectors. Bormann et al (1999) stated that an adaptive management tries to move from technical and physical interactions to more human interactions through a network of social knowledge and information between citizens, scientists and managers. The main characteristics of AWM could be indicated as: polycentric governance,

institutional flexibility and public participation. The origin of AWM and the reasons for selecting these as its defining characteristics will be discussed in more detail later in Chapter 2. However, the understanding of these characteristics within this thesis is outlined below.

Polycentric governance: Under polycentric governance, different institutional settings contribute to policy development and implementation to embrace complexity and diversity (Pahl-Wostl et al 2011). Polycentric governance encourages multiplicity of solutions and boosts dialogue between different authorities (Sovacool 2011, McGinnis 2005). The characteristic of polycentric governance could be recognised through the collaboration and sharing of knowledge and information with external organisations, including government and the private sector (Araral and Hartley 2013).

Institutional flexibility: AWM supports open and shared information sources that fill gaps and facilitate integration within the institutions. The characteristic of institutional flexibility is related to how institutions adjust their strategies and polices over time and also how different individuals and groups interact with each other within the institutions. Adaptive management encourages more interactions between different levels of groups and individuals within the institutions. People inside institutions could have their sharing role in the decision making of their institutions. Accordingly, internal management of the institutions could improve and adjust their policies and strategies over time by considering different views in the institutions (Pahl-Wostl et al 2007).

Public participation: AWM sees public participation in the water management as an essential requirement. AWM encourages broad interaction between the water sector and the public, both as householders and in citizen's groups. Clarke and Brown (2006) highlighted that the sustainable water management requires the participation of individual citizens as well as whole local communities, governmental decision makers, and private sectors. Wouters et al (2012) indicated that the main purpose of public participation is to persuade the people to have a meaningful contribution in the decision making process which provides the opportunity for interactions between decision makers and the public. Public participation could be reflected by how a water institution sees the public role in the water management. However, as indicated by Pahl-Wostl (2005), despite the recognition of public involvement among academics and water planners, the role of citizens in decision making in urban water management has not been well established.

1.2. The rationale for researching AWM

The literature suggests that to address the challenges of water management, more sustainability is needed where different parties involved contribute to water management (Brooks and Brandes 2011, Kayaga et al 2007, Pahl-Wostl et al 2005). The extensive reviewing of the existing literature of AWM as an approach towards more sustainability reveals that there is a shortcoming in what has been researched to date. To the best of this researcher's knowledge, this investigation is one of the few academic studies on the AWM approach in the Middle East region. In this respect, Iran, as a

country situated in the Middle East region, could provide a chance to investigate the attitudes towards AWM by examining the various institutional, governance and social structures, and appraising the suitability of the AWM approach to cities in the Middle East region.

1.3. Research context

The research was conducted within the Greater Tehran urban water management, focusing on two water companies and their water consumers (cities of Tehran and Varamin). This context was characterised by uncertainty and complexity that varied between the cities. The key factors considered were: limited available water resources, rapid population growth, increase in water demand, and excessive use of groundwater. The cities also have the typical water challenges related to similar cities in developing countries, such as improper institutional set-up and the lack of appropriate technologies. As highlighted by Khatri and Vairavamoorthy (2007) the unsuitable institutional set-up of a top-down approach with limited involvement of stakeholders as well as limited access to proper technologies and skilled manpower are the reasons of the failing water management in developing countries.

The water resources of Greater Tehran are very limited; moreover, the population growth is causing a decrease in the amount of available water per capita. It is predicted that in the near future Tehran's water availability will be only 100 m^3 per capita per year (Mokhtari 2013). Some areas of Greater Tehran such as Varamin currently suffer from water shortage as water resources are decreasing so fast. The water challenges of Greater Tehran regarding institutional and social/cultural factors are very complex with no

evident and agreed solutions. In such an environment, the need for sustainability within the water management increases. There is an urgent need for improving the current water management of Greater Tehran for a more sustainable management and addressing the water uncertainty of the future. The decision to conduct the research in Greater Tehran was made by considering two reasons. First, two different cities of Tehran and Varamin provided a comparative foundation for investigating institutional and social/cultural aspects. Second, the case study is selected with a full consideration of accessibility of information, time demands and financial expense for the researcher.

1.4. Research design overview

This research aimed to investigate the current status of the AWM and whether the concept of AWM could be applied in a Middle East urban context. The study was intended to evaluate the concept of AWM through a case study in Greater Tehran to identify the possible patterns regarding water policies among water professionals and water consumers. Considering the research objectives (Chapter 4 p81), a qualitative research methodology was found to be a suitable strategy. The reasons for this qualitative based research choice can be referred to the research objectives concerned with understanding of real world intangible processes and values that are not easily quantified. The research objectives seek to investigate water management challenges, the extent of water policies' adaptability and also feasibility and barriers for using AWM within Greater Tehran. AWM emphasises the need for water companies to work with the public, and for

this reason both water professionals and the public were seen as relevant sources of data. As illustrated in Figure 1.2, the research involved three major stages.

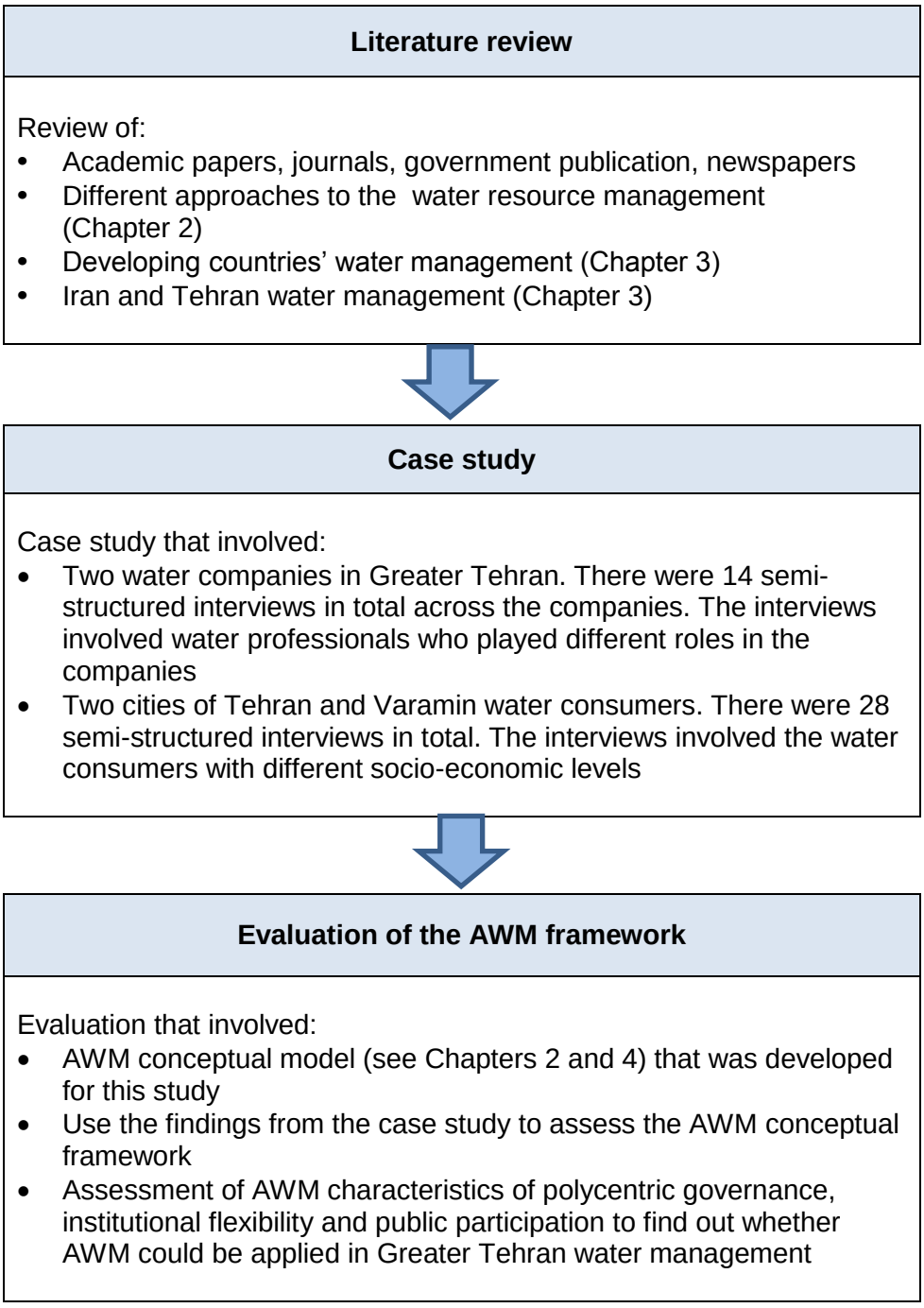

Figure 1.2 Research design summary

The first stage involved a review of the literature related to water management and how it has changed over the last few decades. The review also included AWM, Iran and the Greater Tehran water management literature. The literature review helped address the research objectives and also helped build a framework of AWM for evaluating the current water management strategies through Greater Tehran water companies and water consumers. The second stage involved a case study that included two water companies: Tehran Water and Wastewater (TWW) and South-East Water (SEW) and their consumers. In order to address the research objectives, primary data was collected in Greater Tehran through semi-structured interviews with water industry professionals and with members of the public. In the third stage the findings from the literature and the case study were combined. In particular, water governance of Greater Tehran, institutional process of the companies and the public role in water management were evaluated through a proposed AWM framework.

1.5. Outline of Thesis

Table 1.1 provides a summary of the Chapters' contents in this thesis that is constructed of 8 chapters.

Chapter 2 presents the different water management approaches, models and ideas. This Chapter reviews the relevant literature of water management and current water policies in the urban area. It provides an overview of water management approaches of Water Supply Management (WSM), Water Demand Management (WDM), Integrated Water Resources Management (IWRM) and their current strategies. Furthermore, it discusses AWM and

brings to light some recent AWM approaches such as Soft Path and Sustainable Urban Water Management (SUWM). The Chapter discusses these approaches and their applicability. In addition, it compares WSM and AWM. The Chapter concludes by presenting an AWM framework highlighting the characteristics of polycentric governance, institutional flexibility and public participation.

Chapter 3 highlights key findings from the literature review related to water availability and scarcity focusing on developing countries. In the next step, the literature presents the challenges faced by water management in relation to urban water and also possible future challenges to be faced due to climate change, population growth and water policies in developing countries. The Chapter then discusses the water management in Iran and its challenges. It highlights the current domination of WSM in Iran as the result of the last decades of water management aimed towards modernisation. This is followed by discussion of water challenges of Greater Tehran through the past and the recent water policies.

Chapter 4 identifies and discusses the research design and methodology. Firstly, it presents an overview of the research logic and purpose. Then, it discusses the research approach of the study. Furthermore, it presents and discusses a case study followed by the data collection methods considering the ethical issues. The data analysis method is presented in this Chapter.

Chapter 5 explains and discusses the key research findings regarding the water governance in the case study water companies. The Chapter analyses the institutional arrangements of the TWW and SEW companies and discusses their governance to find out how adaptive the water governance of

the companies are. Furthermore, it examines the companies' collaborations with government and the external organisations. The findings show that the companies of TWW and SEW despite being private in reality are acting as branches of government.

Chapter 6 presents and discusses the key research findings regarding institutional flexibility. Firstly, it discusses the challenges of water management in Greater Tehran. Secondly, it considers institutional flexibility by examining two main issues of the companies' responses to their water challenges (technical and institutional) and the level of interactions within the companies. The findings show that the water management in Greater Tehran has been facing serious technical and institutional challenges. While the institutional challenges are not getting enough attention from the companies' decision makers, addressing the technical challenges would be the main focus of the water management.

Chapter 7 describes the key findings regarding public participation. The findings show that from the companies' perspectives people are water receivers and they want to provide public with the best services. On the other hand, the findings indicated that people are interested in taking part in their city's water management and if they have the opportunity, they would like to engage in water management. People showed their concern about their city's water problems by giving their opinions and speaking about their problems.

Chapter 8 presents the conclusions of the research by highlighting the key findings that address the research objectives. It discusses the conceptual framework of the study and suggests the further research opportunities.

Chapter	Content and purpose
1 Introduction	• Explains research problems and the rationale for researching AWM • Provides research background • Presents an overview of the thesis and the thesis outline
2 Overview of water management approaches	• Reviews the literature of current water approaches and explains their relevance to the research objectives • Provides literature and information that may help to enhance the AWM
3 Water management in the developing world: the example of Iran	• Reviews the literature of the developing countries water management and explains their relevance to the research objectives • Provides literature and information of Iran water management and its challenges. • Describes Greater Tehran water resources • Presents the current policies and strategies of Greater Tehran water management • Highlights the challenges faced by the water managers of Greater Tehran
4 Research design and methodology	• Presents the connection between the research objectives, research design and the required data • Describes the research design, the methods of data collection and the data analysis methods
5 Polycentric governance	• Describes Greater Tehran water companies of TWW and SEW • Highlights the adaptability in the current water governance in Greater Tehran by exploring its decision making process and how is connected with Government and the external organisations
6 Institutional flexibility	• Discusses the water companies' responses to their challenges • Explores the internal management of the companies and how people inside the companies interact with each other
7 Public participation	• Discusses the key issues related to the characteristic of public participation • Explores the companies and consumers' perspectives regarding the current water policies
8 Conclusions	• Highlights the key findings related to the research objectives and discusses the conceptual framework of AWM • Acknowledges the research limitations • Suggestions for opportunities for further research

Table 1.1 Chapters' purpose and contents

Chapter 2

Overview of water management approaches

2.1. Introduction

Water management could be defined as the activities aimed at planning, developing, distributing and operating water resources, surface water, drainage and sewage. Some people distinguish between 'water resource management' (planning, developing and allocating the water resources) and 'water management' (the operation and control of water systems). Water system includes the water cycle and three major interacting elements: physical, biological/biogeochemical, and human components (Craswell 2004).

This Chapter presents a review of the literature that helped to frame the research methodology and understand the results of this thesis. It presents a review of the main water management approaches that have been introduced over the last decades through Water Supply Management (WSM), Water Demand Management (WDM) and Integrated Water Resources Management (IWRM). The Chapter discusses if these approaches could deal with the challenges and uncertainty in the water management in a sustainable way. The idea of sustainable development is supported by the United Nations (1987) that declares social, environmental and economic goals should be pursued simultaneously. Sustainability issue implies that change in one of these areas would result in at least the possibility of an impact on the other two areas (United Nations 1987). Furthermore, this Chapter illustrates what is known about the Adaptive Water Management

(AWM) approach and how it could potentially be an alternative to the current approaches to water management. This Chapter highlights that despite many contributions to the AWM debate in recent years, still there is a lack of clarity surrounding the concept of AWM, and also there is no clear agreement on the measurements for reaching adaptability in AWM. This Chapter tries to take a step forward by developing a conceptual framework (Figure 4.2 p86) before moving on to the research methodology. The framework is intended to evaluate the extent of adaptability in an urban water management by using the three main AWM characteristics of polycentric governance, institutional flexibility and public participation. Accordingly, the Chapter is an important component of the research methodology as it helps build a conceptual foundation for this study. As covered further in Chapter 4, the study aims to investigate the possibility of AWM principles implementation in Greater Tehran through a conceptual framework of AWM (Figure 4.1 p81). The framework facilitates the study for investigating Greater Tehran water management regarding the adaptability. The means of applying this framework are then discussed in more detail in the Methodology Chapter.

2.2. Water Supply Management

The term Water Supply Management (WSM) is used in this thesis to refer to the set of approaches used in water management that are dominated by the development of new water supplies. Bithas and Stofors (2006) stated that the dominant policy of the 20th century aimed at confronting the scarcity of water by utilising new water resources. They highlighted that the socio-economic benefits of transferring water were greater than the costs of exploiting new

resources, and therefore the so-called supply policy prevailed. The excessive use of water resources has increased globally with continued increase in water supplies. As a result, more water supplies caused more water demand by main factors of increases in population and economic growth (Bithas and Stofors 2006). As a similar point of view, Brandes and Brooks (2007) mentioned that the supply management has produced huge benefits and its achievements are impressive. WSM provided widely accessible, high-quality drinking water and reliable sanitation that has allowed communities in middle and high-income countries around the world to flourish (Brandes and Brooks 2007). However, as stated by Bithas and Stofors (2006) these days the efficacy of supply-oriented water approach is questionable. Pahl-Wostl et al (2008) indicated that WSM has a strong engineering tradition formed on controlling environmental problems with technical solutions and despite the many criticisms in recent years a lot of water planners and managers still remain focused on technical solutions and supply development. The major limitations of the WSM concept according to Kayaga et al (2007) are an unsustainable use of water resources, households wasting high quality water (only drinking and cooking need water with high quality) and the use of large quantities of water for transportation of wastes. Xie (2006) identifies that in WSM each sector of domestic use, agriculture, industry and environmental protection has been managed separately, with limited coordination between them that led to fragmented and uncoordinated development of water resources. Without a significant shift in the way water resources are managed and water services are provided Xie (2006) argues the current water crisis will only worsen. WSM has many undesirable consequences for

the environment; water tables are dropping and natural habitats are disappearing; the promise of a safe, abundant supply of fresh water can no longer be guaranteed (Brandes and Brooks 2007). Collectively, the review of WSM highlighted that this approach seems insufficient for the current global water challenges in a sustainable way and as highlighted by Kayaga et al (2007) the supply management needs to change the plan and look more into the other approaches for answering the increasing water demand.

2.3. Water Demand Management

Increasing scarcity of natural resources has made a number of countries pursue more sustainable processes of using of water (Martínez-Espiñeira et al 2014). One of the major challenges for this purpose is to find a balance between water supply and demand by focusing on water consumption behaviour of water users to improve end-use efficiency (Price et al 2014, Da-ping et al 2011). Brandes and Brooks (2007) stated that reducing the demand for water is the best source of “new” water and demand management must become the priority for water management. Demand-side management instead of trying to find new water sources seeks to make the available water supply more productive (Dawadi and Ahmad 2013). The WDM demand reduction measures could be mentioned as: water loss control, water saving devices, water reuse and intermittent water supply, water pricing and water metering. However, these measures may not make a considerable difference in the supply-demand balance if not implemented with other measures (Dziegielewski 2003). For example, the full cost water pricing is one of the most important means of controlling water demand, but,

this strategy might not be very effective without other water demand measures such as leak detection or education campaigns (Sharma and Vairavamoorthy 2009). Moreover, Dziegielewski (2003) highlighted that a lot of WDM measures might have a high cost of implementation and their effectiveness in water conservation has to be tested against the cost of supply increase. It is indicated that most conservation measures need collaboration of water consumers. Therefore, achieving a broad range adoption of various measures is an important challenge for water institutions and with limited experience in dealing with the public (Dziegielewski 2003). As argued by Vairavamoorthy and Mohamad Mansoor (2006) despite these limitations, the demand side approach can be appealing to governments in that it can buy time by postponing the need for large investment in the expansion of the water sector. By delaying an investment, the saving could be achieved and financial resources would be provided to cover the costs of implementing a comprehensive demand management programme (Vairavamoorthy and Mohamad Mansoor 2006).

The next section is intended to examine the water approach of IWRM as a means of addressing the global water problems and working toward a sustainable future for water management (Xie 2006).

2.4. Integrated Water Resources Management

During the 1990s, a new management approach of IWRM has been devised to help meet the challenge of water availability in a sustainable way. Dziegielewski (2003) pointed out that IWRM involves coordinated plans for the utilisation and protection of water resources among many stakeholders,

representing a holistic approach to water. The definition of IWRM according to Global Water Partnership (GWP) (2000 p22) is: *"a process which promotes the coordinated development and management of water, land and related resources, in order to maximize the resultant economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems".*

IWRM strategies are formed on the four principles presented at the World Summit in 1992 (GWP 2012). These are often referred to as 'the Dublin Principles':

- Fresh water is a limited resource, vital to sustain life, development and the environment.
- Water management should be based on involving users, planners and policy makers.
- Women play a significant part in the management and protection of water.
- Water should be recognized as an economic good.

Xie (2006) indicated the key elements of the IWRM are: coordinated process that brings stakeholders together; focused on economic/social welfare and fairness as well as protecting ecosystems; use of scientific data to provide a reliable base for judgment and an emphasis on governance involving democratic participation. As stated by Xie (2006) IWRM is a process, not a product, and that it serves as a tool for assessment and program evaluation. IWRM is a broad set of principles, tools, and guidelines, which must be fitted to the specific context of the country or region or a river basin (Xie 2006). Figure 2.1 illustrates some of the stages involved in both planning, where

many countries have made much progress, and implementation where more attention is needed (GWP 2007).

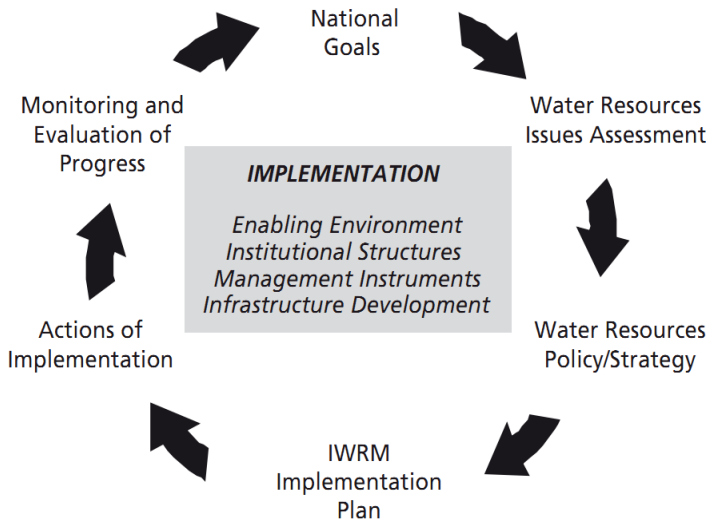

Figure 2.1 Stages in IWRM planning and implementation (GWP 2007 p3)

The IWRM framework provides for an explicit consideration of WDM along with water policies, water legislations, institutional framework, participatory planning and trans-boundary issues (GWP 2000, cited in Dziegielewski 2003 p 30). Jeffrey and Gearey (2006) stated that the most common criticism of IWRM is a gap between theory and practice. They indicated that whilst the concept of IWRM has substantive intuitive influence, it remains a normative theory with focusing on how things should be done (Jeffrey and Gearey 2006). Moreover, Jonker (2007) stated that implementation of IWRM has been vague because of a lack of human capacity in the water sector and also because the conceptual basis of IWRM is not clear. Pahl-Wostl et al (2005) argued that IWRM must be able to respond to changes in the natural and social environment and to anticipate the uncertainties associated with these

changes. According to their view, the current IWRM concept does not elaborate on water management under uncertainty (Pahl-Wostl et al 2005).

2.5. Towards Adaptive Water Management

Historically, water supply can be traced from the 19th century, and was developed to counteract epidemics caused by water-borne pathogens (Kayaga et al 2007). Bower (2000) stated that in 1940s, engineers were the decision makers on water resources issues in absence of economists, biologists, politicians and scientists. He indicated that a positive drift in water resources management accrued in the second half of the 20th century that was shifting from a supply oriented prospect to inclusion of demand management (Bower 2000). According to Gleick (1998), in the 1970s a new debate started on promoting water policies to include issues of sustainability. The discussion on IWRM was started in 1990s as promoting an approach to sustainability. These approaches have been a major part of the water management for years and still are, however, reviewing the literature highlighted the main issues and concerns about them, namely: lack of sustainability and absence of plans to cope with uncertainty. For example, the supply oriented water approach as indicated by Kayaga et al (2007) responses to the water demand increase by development of new water resources. Therefore, such supply management approach is not sustainable and it leads to higher rates of reduction of the limited water resources. WDM is also subjected to the criticisms of being focused more on measures for short-term water use efficiency rather than on long-term ecological sustainability (Brooks and Brandes 2011). Allen (2013) indicated the lack of

transparency and accountability of IWRM to manage uncertainty in the future. It is indicated that despite IWRM's well-established theoretical base, poor implementation of the IWRM principles without enough transparency makes them unrealistic for real success (Allen 2013).

In recent years, there has been a growing interest in the area of Adaptive Water Management (AWM). There is a body of urban water management scholars who are focusing on moving towards more adaptive forms of management approaches to address the current water problems as well as future water uncertainty (Engle et al 2011). As indicated in Figures 2.2, they think AWM has the potential to be one of the main water approaches in the near future.

Figure 2.2 Water management changes from past to future

Doremus et al (2011) stated that over the last two decades, natural resource scientists and policymakers have progressively supported adaptive management. They mentioned that the concept of adaptive natural resource management was developed in the 1970s by two natural scientists: an ecologist (Crawford Stanley Holling) and a fisheries biologist (Carl Walters) who called managers to adjust management direction in a way of what the practices and experiments are shown (Doremus et al 2011). AWM draws on the work of academics (a number of academic disciplines of water science

and water governance), practitioners and water planners who show interest in practicing the adaptive related approaches (see section 2.9 p 34). Claudia Pahl-Wostl (a professor for resources management) contributed considerable academic works in AWM field in the recent years. She emphasised that water management needs to become more adaptive and flexible to operate under fast changing socio-economic boundary conditions and climate change (Pahl-Wostl 2007).

2.6. What is adaptive management?

Adaptive management could be defined as an approach for managing complex systems that builds on learning (depending on common sense, experience, experimenting, and monitoring) by adjusting practices based on what was learned (Bormann et al 1994, Bormann et al 1999). As indicated by Bormann et al (1999) adaptive management tries to go beyond technology transfer to new information and knowledge through a network of social knowledge and information. It focuses on learning and adapting through partnerships based on finding common ground where managers, scientists, and citizens can try to learn together to create and maintain sustainable ecosystems that can support human needs (Bormann et al 1999). As indicated by Bormann et al (1994) the world changes rapidly, both socially and environmentally e.g. the global environment is changing and there are increasingly rapid societal changes. Consequently, these changes suggest a broad scope and an increasingly rapid pace for future change, and ability to adapt to changes. They stated that action should be taken even when the full implications of management actions are unknown, because doing nothing

also has many unknown and poorly predictable effects (Bormann et al 1994). Williams and Brown (2012) mentioned two necessary conditions for undertaking the adaptive management: a mandate to take actions and the institutional capacity to undertake the adaptive strategies. Doremus et al (2011) stated the two key elements of a good adaptive management as: clear setting of goals and plans for learning and commitments to revise management decisions. They mentioned that the first step for considering implementing adaptive management is to evaluate if it's fit in the particular context. It is indicated that adaptive management is not always the answer and it could not be applied to all decisions or situations, the adaptability only should be used when it is likely to improve existing management (Doremus et al 2011).

2.7. Adaptive Water Management

Pahl-Wostl et al (2007) indicated that the transition towards new management paradigms cannot be achieved without understanding the social structure in particular contexts. They mentioned that more systematic recognition of environmental problems is required, including the understanding of the dynamic changes rooted in society, which could be achieved by a process of social learning (Pahl-Wostl et al 2007). On the other hand, despite widespread support of social learning as a normative goal and process in natural resource management, yet there is little agreement over its meaning and social learning's lack of transparency would limit the capacity of its assessment (Reed et al 2010, Armitage et al 2008). Social learning has various meanings depending on different theoretical

traditions and understandings (Blackmore 2007). As indicated by Reed et al (2010) it is necessary to differentiate social learning from the conditions that might facilitate it such as stakeholder participation. However, what is the scope of social learning in the context of AWM? Reed et al (2010)'s discussion highlighted three outcomes regarding the process of social learning that are meant to happen in AWM concept. They argued that in a process of social learning, firstly, the individuals involved should show a change in understanding, secondly, the change becomes established within wider groups. Lastly, the change appears and is practiced between various actors within a social network (Reed et al 2010). This explanation of social learning helps understand the further discussion in the following section regarding AWM principles. Accordingly, the next section highlights the extent to which social learning occurs in water governance decision making process, to what extent social learning is facilitated by individuals and groups within institutions and to what extent social learning leads to a better understanding of water consumers and other external stakeholders.

2.8. Adaptive Water Management characteristics

For highlighting the main principles of AWM, this section presents a comparison between characteristics of AWM and WSM (the most widely practiced water management approach) (Table 2.1). As can be seen in Table 2.1 the AWM approach can be differentiated from WSM by three main characteristics of polycentric governance, institutional flexibility and public participation.

Characteristic	Water Supply Management (WSM)	Adaptive Water Management (AWM)
Governance	**Centralised governance** Decision making is centralised and is shaped by legal instructions	**Polycentric governance** Decision making is polycentric and is shaped by collaboration of various organisations involved in water sectors
Institutional process	**Technical flexibility (predict & control)** Problems are defined by technical experts based on prediction and control Lack of knowledge sharing and communication within the institutions	**Institutional flexibility (social feedback & adjustment)** Challenges are defined by cross-sectoral examination based on social feedback and adjustment Supporting open and shared information sources that fill gaps and facilitate integration within the institutions
Public role	**The recipients of water** Little interaction between the public and the different parts of the water sector	**A part of water management** Broad interaction between water sector and the public, both as householders and in citizen's groups

Table 2.1 AWM and WSM comparison

(Developed from material in Pahl-Wostl et al 2011, Pahl-Wostl 2007, and Pahl-Wostl et al 2006)

2.8.1. Polycentric governance

Under polycentric governance, different institutional settings contribute to policy development and implementation to embrace complexity and diversity (Pahl-Wostl et al 2011). Polycentric governance encourages multiplicity of solutions and boosts dialogue between different authorities (Sovacool 2011, McGinnis 2005). The characteristic of polycentric governance could be recognised through the collaboration and sharing of knowledge and information with external organisations, including government and the private sector (Araral and Hartley 2013). By distribution of authority and bringing together different values, preferences and viewpoints, the decision making process transparency improves, and this enables management to respond to uncertainties (Williams and Brown 2012, Pahl-Wostl et al 2012). In order for polycentric governance to work, the nature of the interaction between various actors of networks should be identified, so if one of the actors (e.g. a private sector) fails on a problem solution, there are other actors that could address the task (Sovacool (2011) Pahl-Wostl et al 2012). Williams and Brown (2012) highlighted that polycentric governance does not recommend the exact number of organisations being appropriate for involvement in decision making, and who the decision maker should be, and how they should be organised. Some situations might involve a few decision makers to work with each other; in other situations a large number of stakeholders may interact in a structured way (Williams and Brown 2012).

However, putting polycentric governance in practice as indicated by Sovacool (2011) is not without challenges; it needs a combination of local, national, and international regulations that can lead to confusion as people try to work

out what applies to them. Yet, there is no guarantee that polycentric approaches could produce effective solutions (Sovacool 2011). In addition, diversity of stakeholder groups can lead to conflicts, some managers prefer to have fewer stakeholders to minimise the risk of conflicts (Williams and Brown 2012). Moreover, as mentioned by Sovacool (2011), the constant changing arrangements of polycentric governance could become dysfunctional. Some difficulties in relation to polycentric governance are mentioned by Huitema et al (2009) such as, the lack of monitoring data, attribution problem, and also concerns about transaction costs and accountability. Besides, according to the literature more evidence is needed about the effectiveness of the polycentric governance.

Overall, the above discussion provided a brief overview of the recent debate on the polycentric governance. The discussion highlighted social learning as a key role in polycentric governance to develop mutually supportive practices amongst various layers of social network. As highlighted Ostrom (2010) polycentric approaches facilitate achieving benefits on multiple scales, as well as experimentation and learning from experience with diverse policies. Similarly, Von Korff et al (2012) emphasised that the concept of adaptive management is closely linked to the concept of social learning, emphasizing collaboration and the development of shared practices between different stakeholders.

The next section will discuss another AWM characteristic of institutional flexibility and highlights the extent of social learning within institutions.

2.8.2. Institutional flexibility

While the process of WSM is prediction and control (technical flexibility) AWM moves towards more flexible strategies based on the social feedback and adjustment (institutional flexibility). Pahl-Wostl et al (2005) defined AWM as a systematic process for continually improving management policies and practices by learning from the outcomes of implemented management strategies. As indicated by Bormann et al (1994), all of the views of adaptive management have a common thread of feedback and adjustment. 'Feedback' refers to knowledge or data on the effects or results of an action that have been collected; 'adjustment' is using knowledge and data produced by feedback to redirect subsequent action (Bormann et al 1994). The adaptive management process indicates a number of different adjustments and feedback, and, as a result, the improvement and adaptability would be provided during the time. Accordingly, the strategies could change and repeat considering the circumstances of the individuals and the groups' behaviour/interaction in the institution for reaching the desirable outcome (Pahl-Wostl et al 2007) (Figure 2.3).

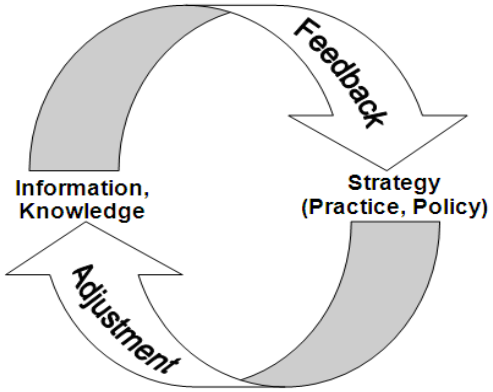

Figure 2.3 Process of adaptive management

Institutional flexibility highlights the extent of social learning which promotes more interaction between individuals and groups within the institutions to gain and share more social knowledge and information. Bormann et al (1994) indicated that institutionalising adaptability requires that people think about, and question every decision and every action. They stated that principles are important, but they must be changed when new information confirms a change (Bormann et al 1994). Pahl-Wostl (2009) indicated that in social learning, change is a step-like arrangement moving from single learning to a network of learning. In this social learning network process within AWM, the importance of the nature of multi-level interactions and how it is facilitated by individuals and group interaction is emphasised. Hence, a better balance between bottom-up and top-down interactions leads to higher adaptive capacity (Pahl-Wostl 2009). According to Williams and Brown (2012), adaptive management supports flexible decision making that can be adjusted in the face of uncertainties. For a system to be able to adapt to change, or to be prepared for uncertain future change, two aspects are key requirements; these are the availability of the new information to the system, and the ability to process the new information (Pahl-Wostl 2007). As highlighted by Pahl-Wostl (2009), a desirable direction of institutional change is a balance between formal and informal institutions that accompany each other. It is indicated that formal and informal refer to the nature of processes of organisation, communication and enforcement. Overall, institutional flexibility is about greater consideration for social structure and learning within institutions.

2.8.3. Public participation

Whereas WSM considers people as water receivers, AWM sees public participation in the water management as an essential requirement. Public involvement and participation is the basic need for achieving a sustainable development (Tomas 2006). Wouters et al (2012) indicated that the main purpose of public participation is to persuade the people to have meaningful contribution into the decision making process which provides the opportunity for interactions between decision makers and the public. However, as highlighted by Jami and Walsh (2014), this participation comes with some key challenges that could restrict the advantage of public participation in making policy decisions. They mentioned some of these challenges as: more time consuming procedures, partial understanding by public, individual differences in values and conflicts of interests (Jami and Walsh 2014). Clarke and Brown (2006) highlighted that the level of participation of individuals and communities depends on the level of awareness that is given to the public with consideration of their culture and beliefs because participation of the public is embedded in individuals' beliefs, emotions and interests (Clarke and Brown 2006). Despite the recognition of public involvement among academics and water planners, Pahl-Wostl (2005) emphasised that the role of citizens in decision making in urban water management is not well established, and the lack of information prevents citizens from becoming more involved in decision making process. The role of the public in water management seems complicated. Blake (1999) mentioned the policies of governments, business and even international organisations that fail to match up to the environmental concerns people are expressing. As mentioned by

Miller et al (2006), despite relatively high levels of awareness and concern for the natural environment, the average citizen contributes to environmental degradation through their daily behaviours, habits and choices. Blake (1999) mentioned the existence of a gap between the knowledge and actual behaviour of water consumers. This is called the “value-action gap” and is seen as of key importance to environmental policy, because it is repeated at other scales, involving different actors (Blake 1999). Blake (1999) highlighted the value-action gap by asking the respondents themselves to identify the barriers or reasons that prevented them from carrying out particular environmental actions, despite a general concern for the environment. The results confirmed both psychological and institutional factors affect individual action. Which factors are important in any one case will vary for different individuals, environmental actions, and social or institutional constraints (Blake 1999). The individual’s behaviour could be changed through receiving related knowledge and information that makes them take responsibility and participation. However the assessment would not be complete without considering the factors involved in value-action gap and also the public expectation from the decision makers.

The discussion above highlighted that despite many contributions to the AWM debate in the recent years, still there is a lack of clarity surrounding the concept of AWM, and also there is no clear agreement on what the measurements for reaching adaptability in AWM are. This research tries to take a forward step by evaluating the extent of adaptability in water management by using three AWM characteristics of polycentric governance, institutional flexibility and public participation (Table 2.2).

Characteristics		Does not conform with AWM principles if:	Conforms with AWM principles if:
Governance	Decision Making	Decision making achieves by one single authority	Decision making achieves by cooperation of various stakeholders
	Interaction with external organisations	Lack of knowledge share and communication with other organisations	Sharing the social knowledge and information with other organisations
Institutional process	Responses to water challenges	Technical flexibility (predict and control)	Institutional flexibility (social feedback and adjustment)
	Interaction within Institution	Lack of knowledge sharing and communication	Encouraging individuals and groups interactions
Public role	Water companies' perspective	People as the recipients of water only	People as a part of water management

Table 2.2 Adaptability in governance, institutional process and public role

As can be seen in Table 2.2, adaptability in governance could be indicated by two issues, involving several stakeholders in decision making, and sharing the social knowledge and information with these external organisations. Adaptability in institutional process could be emphasised by institutional responses to the challenges (technical and institutional), and the level of interactions between individuals and groups within the institutions. The adaptability of institutions regarding the public role could be underlined by people's participation in water management.

2.9. Adaptive Water Management related approaches

This research is taking the term AWM to include a number of different approaches which have emerged in recent years, all of which have similar characteristics such that they can broadly be seen as adaptive. This Section discusses why these approaches are categorised under the AWM umbrella. Two newly introduced approaches of Soft Path and Sustainable Urban Water Management (SUWM) are being examined in this section. Soft Path and SUWM approaches are mainly known in Canada and Australia respectively. These approaches are in the beginning of their implementation, and for now they rely more on a theoretical basis rather than a practical foundation. Reviewing the literature highlighted that these approaches, despite having different framework, have similarities in their primary objective (e.g. to achieve a sustainable water management) and outcomes (e.g. harmony with the water cycle). These approaches are intended to shift water management towards more multidisciplinarity. For example, as indicated by Wolff and Gleick (2002), the Soft Path promotes more interactions between government, private companies and individuals. In addition, these approaches are adaptive to the uncertain future. For example, as stated by Keath and Brown (2009), the SUWM approach is ready to respond to unpredicted future conditions. As will be argued below, Soft Path and SUWM have sufficient characteristics in common with AWM, and therefore might be regarded as AWM under a different name.

Soft Path

Wolff and Gleick (2002) referred to two paths for water management, the traditional path as the “hard path” and the newer, alternative path as the “Soft Path”. According to Brandes and Brooks (2007), the Soft Path gets its name because it mainly relies on human ingenuity and innovation to solve society’s water problems, and it is gentler on the environment, working with nature rather than trying to overcome it, and is a planning method for fresh water which differs fundamentally from conventional, supply-focussed water planning. Brooks and Brandes (2011) indicated that Soft Paths are a long-term approach to water management; they need time for gradual replacement of existing physical infrastructure. In this way, the approach of Soft Path may coexist with WDM for many years to come, and as a result, time allows new norms of behaviour or forms of social infrastructure to be evaluated. Soft Path goes beyond efficiency by fundamentally challenging today’s patterns of freshwater consumption, by focusing on ‘why’, the Soft Path greatly increases the number of possible solutions (Brooks and Brandes 2011). According to Brooks and Brandes (2011) Soft Path planning at first defines a sustainable and desirable future state for society, and then works backward to identify policies and programmes. Back-casting technique is an important practical differentiation from traditional approaches; it is also likely the most difficult part of Soft Path analysis and planning. Brooks and Brandes (2011) indicated that in Soft Path options are intended to match the quality of water supplied to the quality required by the specific end-use, by creating circular cascading systems so that wastewater from one use, becomes the input for another use, e.g. from rainwater capture to the washing machine,

and then to the garden. Table 2.3 presents the main features of the new path and its differences regarding WSM and WDM (Brandes and Brooks 2007).

Policy	Dominant discipline	Range of policy choices	Fundamental question	Planning process	Outcome
WSM	Engineering	Policies based on presumed need for new infrastructure	How can we meet projected water needs given current trends in water use and population growth?	Planners extrapolate from current consumption patterns to determine future "requirements" and then locate and develop new sources of supply to meet this projected demand	Construction of dams, pipelines, canals, wells, desalination systems, and inter-basin transfers, where necessary
WDM	Economics	Policies based on short-term cost-benefit calculations	How can we reduce needs for water to conserve the resource, save money and reduce environmental impacts?	Planners incorporate efficiency and information programs together with improved pricing patterns to maximize use of existing infrastructure Increasing capacity is only one option among others in a least-cost approach	Efficiency gains through technical fixes and consumer education
Soft Path	Multi-disciplinary	Policies based on stakeholder consultation and political review	How can we deliver *services* currently provided by water in ways that recognize the need for economic, social and ecological sustainability?	Planners model a sustainable future state for water use with attention to long-term economic and social prosperity. They then "back-cast" to devise a feasible and desirable path to reach that state. Ecological sustainability is fundamental to all economic, political and socio-cultural choices	Options to reduce water use through innovation, conservation, water reallocation and changing patterns of use and re-use

Table 2.3 A spectrum of water management approaches

(Brandes and Brooks 2007 p4)

According to Wolff and Gleick (2002), the Soft Path redirects government agencies, private companies and individuals to work to meet the water-related needs of people and businesses, rather than just to supply water. In this way, the managers could expand their focus beyond traditional technologies and large-scale built infrastructure by changing practices and behaviour, which offers a range of ways to reduce water use while maintaining desired services (Brooks and Brandes 2011). Brooks and Brandes (2011) pointed out that the term 'water Soft Path' is not well known outside the United States and Canada. However, the core principles inherent in Soft Paths are increasingly apparent elsewhere, notably in the European Union and other Organisation for Economic Co-operation and Development (OECD) countries.

Brandes and Brooks (2007) mentioned that the Canadian water Soft Path study is the first test anywhere in the world, on the application of water Soft Path concepts, to specific political jurisdictions in specific ecological and geographic settings. This indicated that this approach has very little practice in the real world, and the whole approach is formed on a theoretical foundation for now. They also added the long term strategies of the Soft Path as a negative fact for this approach, when there are many cases in the water conservation management that need a short term solution (Brandes and Brooks 2007). In relation with Soft Path Approach there are few examples due to the long-term practicing on the ground. According to Brooks and Holtz (2009), the concept of Soft Path for water is a long-range planning approach; they mentioned a study undertaken by Friends of the Earth Canada in conjunction with research teams at three Canadian universities. The studies

were designed primarily to test the analytical method, not to achieve immediately applicable results and developed scenarios for water use over the next 30 or 40 years.

Sustainable Urban Water Management (SUWM)

As indicated by Keath and Brown (2009) SUWM emphasises a system approach which is adaptive and ready to respond to unexpected outcomes by being prepared for multiple potential future conditions (Keath and Brown 2009). According to Dong (2004) all strategies of the SUWM (e.g. technological solutions, demand management, Water Sensitive Urban Design (WSUD) and localised management) are vital, but implementation is slow. It seems that the WSUD as a part of the SUWM is getting more popular among water managers as it has the ability to be applied to varied situations and structures (Dong 2004). As mentioned by Lloyd (2001) WSUD aims to minimise the impact of urbanisation on the natural water cycle, and its principles could be applied to the design of a single building or to a whole subdivision (Lloyd 2001). Hoyer and Dickhaut (2010) highlighted three case studies from different countries conducted at the different scales of WSUD. The first case study was in the city of Rotterdam in the Netherlands, the second case study was a project in the city of Hamburg in Germany, and the third case study conducted in Portland, Oregon in the USA. All the case studies were intended to find an innovative way for managing the storm-water and drainage such as green roofs and water gardens (Hoyer and Dickhaut 2010). Beecham (2003) stated that the major challenge with WSUD is now to assist designers to develop their cross-disciplinary skills and to

encourage a widespread adoption of the technology which requires strong linkages with professional practice to decrease the cultural, and structural impediments to cross-disciplinary activities. It is indicated that the designers of WSUD will continue to be challenged by social, cultural, technological and business developments, and there will be a constant need to find novel solutions. WSUD requires an innovative approach and therefore a degree of risk taking (Beecham 2003). As shown in Table 2.4 Soft Path and SUWM have common grounds in the disciplines that they follow, the nature of their primary objective, and what they generate as the outcome.

Approach	Discipline	Primary objective	Outcomes
Soft Path	Multidisciplinary	Identifying sustainability for economic, social and ecological in water services	Options to reduce water use through innovation, conservation, water reallocation, and changing patterns of use and ruse
SUWM	Multidisciplinary	Towards sustainable cities, including their ecological, economical, social and cultural aspects	The harmony with natural water cycle, water reuse(e.g. roof water to toilet), water collection, water conservation

Table 2.4 Water management approaches of Soft Path and SUWM

Reviewing the literature highlighted the common ground of two approaches of Soft Path and SUMW and what makes them to be seen as adaptive in this

research. As can be seen in Table 2.4 the dominant discipline for both approaches of Soft Path and SUMW is multi-disciplinary. This means that different information is considered from different fields to achieve their goals, similar to AWM. Moreover, the literature highlighted that Soft Path and SUWM have same primary objectives to achieve a sustainable water management equivalent to AWM (Keath and Brown 2009). In addition, both approaches of Soft Path and SUWM have the same outcomes such as water conservation which is desired and encouraged by AWM.

2.10. Chapter summary

This Chapter reviewed and investigated the main water management approaches. As highlighted in the Chapter, water management in developed countries experienced the main approaches of WSM, WDM and IWRM during the last decades. The Chapter highlighted the limitations of these approaches regarding the sustainability and responding to the future water uncertainties. The Chapter brought to light the AWM application as an alternative approach to address the current water challenges, and future uncertainties of water management in a sustainable manner. The Chapter described what is known about AWM, and shed some light on the AWM characteristics of polycentric governance, institutional flexibility and public participation. Different approaches of AWM were identified as a possible sustainable management of water resources to meet the current, and the future of water security, compared to WSM. The Chapter highlighted the lack of adequate research in the area of AWM especially in the developing countries. The Chapter tried to bring to light the following questions regarding

the comparison of AWM and WSM, the most practiced water approach especially in developing countries.

- Whether developing countries need to follow the same water management development path as applied for the developed countries.
- Whether it is possible for developing countries to implement AWM by moving from the current water management practices such as WSM.

Accordingly, there is a need to investigate the potential gaps between current water management and the willingness to move more towards AWM in developing countries. Reviewing the literature in this Chapter was a fundamental component of the research methodology as it helped to build a conceptual framework to explore the Greater Tehran water management adaptability.

The next Chapter discusses the water management approaches, and their current situation and challenges in developing countries. Iran, as a developing country situated in the Middle East could provide the opportunity to examine the motivations towards AWM, as a reflection of the region regarding the various institutional and social structures.

Chapter 3

Water management in the developing world: the example of Iran

3.1. Introduction

The review of the literature in this Chapter helps to understand the research context of this thesis. The aim of this Chapter is to scope the water approaches currently operating across developing countries, in order to understand the capacity development needed to transition towards more adaptive management. The Chapter presents a big picture of water availability, and the factors influencing the water availability with a focus on developing countries. It highlights the main water challenges in the developing world, and discusses how the water management of Iran is facing these challenges. The Chapter provides an understanding of the study context for the detailed findings, with regards to the specific water companies in Greater Tehran, and aims to address the water challenges of Greater Tehran. Information is extracted from the Governmental documents, water companies' websites, and academic papers related to the water management in Tehran. It should be explained that the term "Tehran" in this Chapter means the city of Tehran and term "Greater Tehran" means the city of Tehran and all its cities and towns.

3.2. Water availability the big picture

Water availability generally refers to the volume of water available, from a basin or stream, at a specified point over a specified period of time (National Institute of Hydrology 1998-99). According to Clark and King (2004), only

2.5% of the world's water is fresh, and more than two-thirds of this is unavailable for human use. The basic problem is that the volume of fresh water on the Earth's surface is fixed, and less and less water is available per person as populations grow and the aspirations of individuals increase (Clark and King 2004). Water insecurity as indicated by United Nations Development Programme (2006), poses a threat to human development, some 1.1 billion people in developing countries have inadequate access to water, and 2.6 billion people lack basic sanitation. According to UN-Water (2006) by 2025, 800 million people will be living in countries or regions with absolute water scarcity and two-thirds of the world's population could be under severe water stress conditions. Office for the Coordination of Humanitarian Affairs (OCHA) (2010) highlighted that presently, almost one-fifth of the world's population live in areas of physical water scarcity. Water scarcity as stated by UN-Water (2006) is imbalance between availability and demand, and can occur at any level of supply or demand. Scarcity may be a social construct, (a product of prosperity and habitual behaviour) or the consequence of climate change. As mentioned by UN-Water (2006), scarcity often has its roots in water shortage, and in the arid and semi-arid regions, is affected by droughts and wide climate variability, combined with population growth and economic development that makes scarcity most severe (UN-Water 2006). Black and King (2009) stated that the problem lies in the mismatch between where the rain falls, and where people live. In many densely populated places, the renewable water resource is insufficient, thus leads to water being extracted from rivers and underground aquifers at an unsustainable rate. Increasing population, expanding cities, and the water-

rich lifestyle are combining to cause critical localised shortage (Black and King 2009). As indicated by World Bank (2013) the Middle East and North Africa Region (MENA) is the most water scarce region in the world (Figure 3.1). One half of MENA's population lives under conditions of water stress. Water withdrawals are predicted to increase by 50 percent by 2025 in developing countries. For example, by 2025, the MENA region is set to experience a decline of per capita annual renewable water resources from 750 m^3 to 500 m^3. With continued climate change and urbanisation, these countries will face growing challenges related to water management (OCHA 2010, Global Environment Outlook 2007).

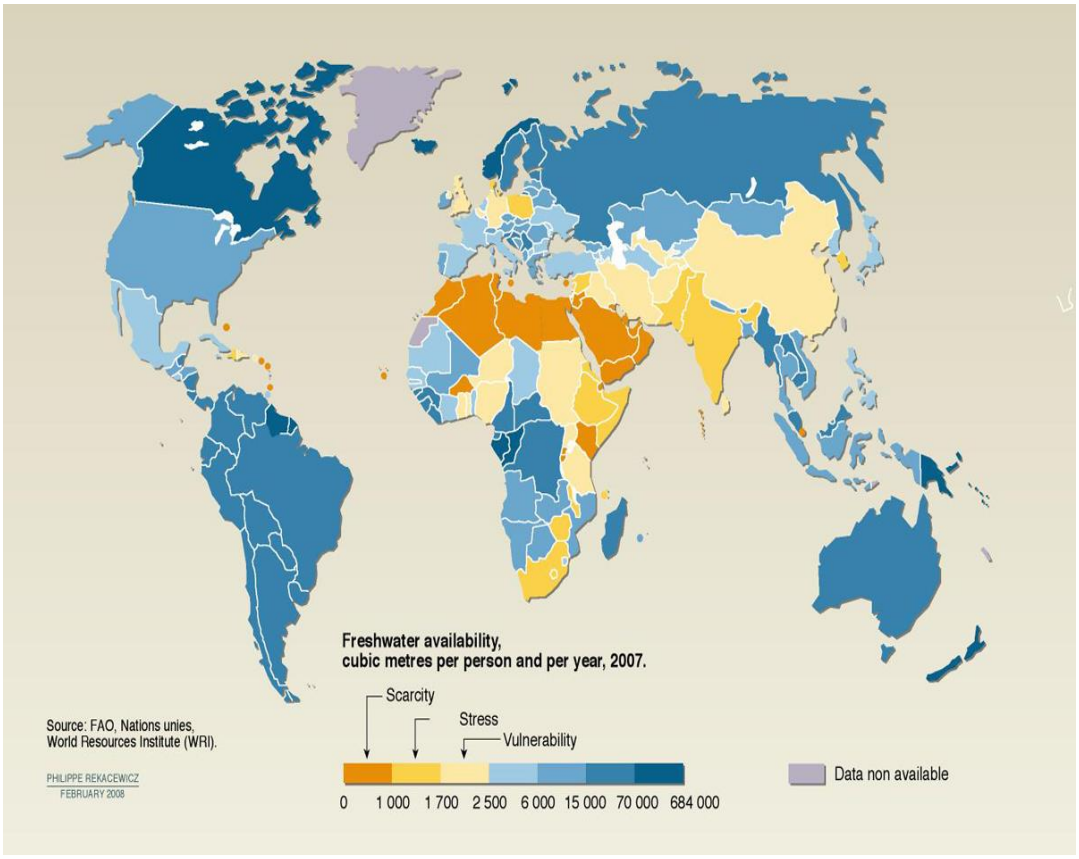

Figure 3.1 Global fresh water availability

(United Nations Environment Programme 2008)

Is the water availability secured for us through the future? This is a key question in the water management. Escalating water resources scarcity is a vital problem around the world, even in the areas with adequate water resources, for example Sharp (2006) states that even in the stereotypically wet countries of England and Wales, Water Demand Management has been a subject of increasing attention over recent years. However, according to Falkenmark et al (2007), in spite of the fact that physical water scarcity is an appalling reality for millions of people, it is still not properly understood nor recognised in many front-line discussions. The next section reviews the factors that are influencing the current water availability.

Factors influencing water availability

The most associated factors with water availability could be indicated as: climate change, human behaviour and inappropriate water management.

Lins and Stakhiv (1998) stressed that among the many concerns associated with global climate change, the potential effects on water resources are frequently cited as the most worrisome. Falkenmark et al (2007) indicated that as an impact of climate change, many rivers are already going more or less dry before they reach their outflow. Oki and Kanae (2006) emphasised that higher temperatures made by climate change may cause the sea level to rise, and this will cause salty water intrusion into groundwater aquifers near the coasts, and will decrease the available groundwater resources. They mentioned that the effect of global climate change on hydrological cycles is still uncertain (Oki and Kanae 2006). According to van der Zaag et al (2009) climate change is one of the most important water problems that is not

getting enough contribution from the water scientists. They argued that there is not enough research conducted, especially by developing countries despite wide acknowledgement that climate change will hit these countries hardest.

Moving to the human influences on water availability, the study by Kummu et al (2010), showed that the effects of changes in population on water shortage over the time period of 1960 to 2005 are about four times as important as changes due to climatic change. They mentioned that the most widespread water shortage is in South Asia, where 91% of the population experiences some form of water shortage, and the most severe shortage is in North Africa and the Middle East, where 77% and 52% of the total population live under extreme water shortage respectively (Kummu et al 2010).

Inappropriate water management is another factor influencing water availability as mentioned by some authors. Xie (2006) indicated that the current water issues are often more of a crisis of governance, weak water service providers fail to serve the public, and social and environmental concerns are left unaddressed (Xie 2006). Cosgrove and Rijsberman (2000) claimed that the water resources have been threatened with bad institutions, bad governance, bad incentives, and bad allocations of resources. They indicated that worldwide, industry uses twice as much water as households. The most obvious uses of water for households are drinking, cooking, bathing, and cleaning (Cosgrove and Rijsberman 2000). As a result according to Medd and Shove (2006), water problems occur as an outcome of interaction between the different components, rather than reflecting any one single cause. They stated that times of crisis draw attention to the roles,

responsibilities and expectations of water regulators, companies, and consumers. Consequently, applying effective water policies to prevent more damage to available water resources seems essential (Medd and Shove 2006).

3.3. Water challenges in developing countries

According to Sharma and Vairavamoorthy (2009), urban water supply systems in developed countries are well established, and infrastructures are well structured. Water supply systems in these countries are reliable and stable with adequate water pressure, and they have proper water distribution system information. There is a reasonably small rate of growth of both the population, as well as the urban water demand. In addition, developed countries are using various technological and management measures to reduce urban water demand as a part of their integrated urban water management strategy (Sharma and Vairavamoorthy 2009).

In contrast, in developing countries, as mentioned by Khatri and Vairavamoorthy (2007), historically the performance of urban water systems (the combination of infrastructure, and institutions, and their components/relations) remains below expectation. For example Rudolph (2008) stated that water losses in most developing countries are quite high compared to European countries (Figure 3.2). The poor operations and maintenance of existing facilities is the main reasons for water losses in developing countries (Rudolph 2008).

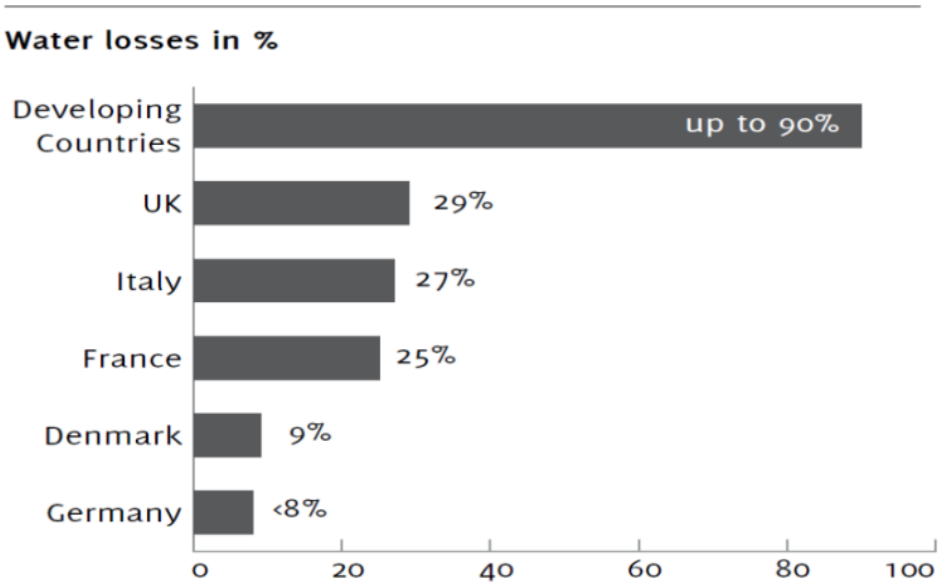

Figure 3.2 Water loss figures from different countries (Rudolph 2008 p31)

Abbaspour (2011) stated that dealing with water problems in developing countries suffers from restricted funding, combined with unstable institutions and limited technical capabilities. Khatri and Vairavamoorthy (2007) indicated that the failing of systems, particularly in developing countries, has been partly the result of a top-down approach with limited involvement of stakeholders, as well as they might not have access to proper technologies and skilled manpower. They highlighted that, the weakness of the water management is related to the unsuitable institutional set-up, and the lack of understanding of the institutional background in which the urban water system is managed and operated (Khatri and Vairavamoorthy 2007).

Overall, water management in developing countries suffers from the common water problems beside the challenges of climate change, and insufficient renewable water resources. Figueres (2005) highlighted some of these common challenges as: water resource scarcity, aged infrastructure, high water losses, high rate of growth of population and poor institutional

framework (Figueres 2005). As highlighted by World Bank (2013), some MENA countries have responded to scarcity by investing in infrastructure, and they lead the world in applying non-traditional water technologies, such as desalination and wastewater re-use. However, these investments have not always been accompanied by the necessary institutional and policy changes, and are often not generating optimum economic returns. World Bank (2013) highlighted that the key challenges of MENA countries' urban water are: unsustainable and inefficient water use, and ineffective policies and deteriorating water quality. The MENA countries need to improve institutional governance and regulations, conduct inter-sectoral coordination, and open the sector up to civil society (World Bank 2013). All of this highlights the uncertainty of the future for water management and the lack of the appropriate and institutional set-up in developing countries. However, a lot of developing countries are trying to overcome their water challenges by implementing various approaches of water management. The following section highlights some of the developing counties experiences in water management with different levels of success.

3.4. Water management experiences in developing countries

This section reviews some of the developing countries' experiences to overcome their water problems. The section highlights that these countries are trying to depart from supply-oriented approaches by trying Water Demand Management (WDM) strategies, and also practicing the strategies that are compatible to their regions. Moreover, the experiences show that

developing countries need to enhance their institutional arrangements and their pursuing awareness process.

According to Babel et al (2010), Bangkok the capital city of Thailand is facing enormous challenges of providing reliable and safe drinking water. Bangkok has a large population of over five million, and domestic and industrial water supplies in the city are provided by a combination of surface water and groundwater. According to their study, meeting future water demand requires departure from heavy reliance on supply-oriented approaches, which in turn needs more aggressive implementation of demand management measures. Bangkok's experience showed that implementation of concrete demand management measures to obtain substantial and meaningful outcomes, requires strong cooperation from the consumers and relevant government agencies (Babel et al 2010).

The results of the study conducted by Al-Anzi et al (2012) showed that the country of Kuwait, (located in the Middle East with access to the Persian Gulf) had achieved more than 50% reduction in volumes of wastewater discharged into the sea from year 2000 to year 2010. However, their study predicted that the amounts of wastewater discharged into the sea will start increasing again by the year 2020, due to shortages of storage capacity for reclaimed wastewater, and the limitation of wastewater reuse applications to basically agricultural and landscape irrigation. In contrary, the on-going works and future plans of the government are expected to overcome this problem, and lead to a zero discharge of wastewater into the sea (Al-Anzi et al 2012).

Herbertson and Tate (2001) stated that Namibia, a country located in sub-Saharan Africa, has substantial experience of Water Demand Management. Treated sewage is used through a dual pipe system for municipal irrigation. They mentioned that despite a 35% population increase, the success of integrated WDM measures resulted in zero overall growth in water consumption over the period 1990-97.

Egypt is an arid country located in the North of Africa and depends on the Nile River. As indicated by Abdin and Gaafar (2008), the shift to demand-managed water culture policy is imperative for Egypt. They stated that a number of measures towards the rational use of water were already applied, but still need extra efforts. Enhancing the institutional organisations, involving the private sector, strict laws and cooperation with the Nile Countries are considered a must to increase the water use efficiency, control water demand, and reduce the over irrigation and the misuse of water (Abdin and Gaafar 2008).

According to Julio and Alegria (2006), Peru, a country in western South America suffers from water scarcity. They argue that problems largely stem from the inadequate water policies, the ineffective water authority, and the weak institutional arrangements. They stated the need of pursuing through education and an awareness process as a new paradigm for sustainable water resources development (Julio and Alegria 2006).

According to Heath et al (2012), there is a growing recognition of the adaptation to the climate change in African countries. According to Heath et al (2012), since 1990, the urban population of sub-Saharan Africa has more than doubled, which makes the climate change impacts more complicated. They stated that applying Rapid Climate Adaptation Assessment in Lusaka, Zambia, highlighted the fact that adapting to climate change does not necessarily involve entirely new processes or techniques; instead, it requires a combination of capacity building, and technological and managerial measures (Heath et al 2012).

3.5. Iran water management

This section reviews the water management of Iran. The context of Iran, its water resources, and the last 100 years of water management of the country will be roughly explained. This is important for understanding the further arguments in this thesis.

3.5.1. Geography and water resources

Iran is located in the southwest of Asia in the Middle East region (Figure 3.3). It has a population of approximately 75 million with 53.6 million (71.4 percent) urban population. Tehran, the capital city has a population of around 8 million people (Statistical Centre of Iran 2012).

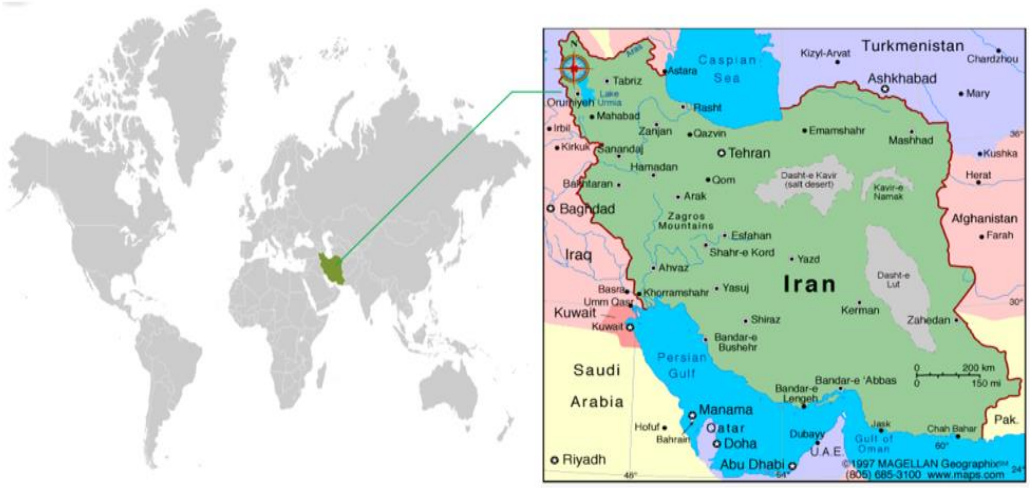

Figure 3.3 Geographical location of Iran (Infoplease 2014)

Iran has an area of 1,648,149 square km. The main physiographic features of Iran could be mentioned as Zagross and Alborz mountain ranges, striking northwest-southeast and west-east respectively, the central Kavirs or deserts, the Caspian Sea to the north and Urmia Lake to the northwest part of the country. As pointed out by FAO Water Reports (2008), Iran is divided into 6 main basins which are (Figure 3.4):

1. The Caspian Sea basin in the north (Khazar),
2. The Persian Gulf and the Gulf of Oman basin in the west and south,
3. The Lake Oroomieh basin in the northwest
4. The Central Plateau in the centre (Markazi),
5. The Lake Hamoon basin in the east (Mashkil Hirmand),
6. The Kara-Kum basin in the northeast (Sarakhs)

All these basins, except the Persian Gulf and the Gulf of Oman basin, are interior basins. Almost half of the country's renewable water resources are located in the Persian Gulf and the Gulf of Oman basin, which only covers one fourth of the country.

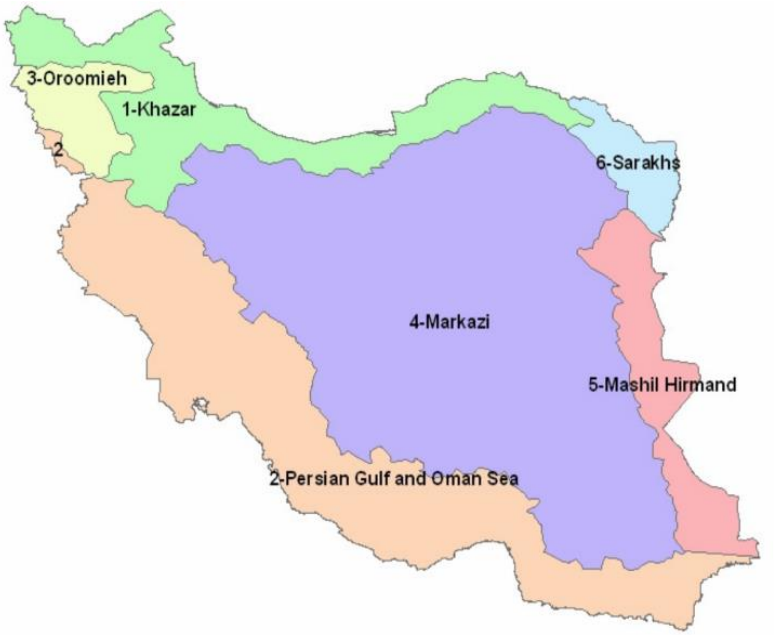

Figure 3.4 Major basins in Iran (FAO Water Reports 2008)

The Markazi basin, covering over half of the country, has less than one third of the total renewable water resources. The Caspian Sea is the largest landlocked water body in the world, and its surface lies about 22 metres below sea level (Table 3.1) (FAO Water Reports 2008).

Basin	Area (×10ˆ3 Km^2)	Total area of the country (%)	Renewable water resources (%)
Caspian Sea	177	10	15
Persian Gulf and Gulf of Oman	430	25	46
Lake Oroomieh	53	3	5
Markazi	831	52	29
Lake Hamoon	106	7	2
Sarakhs	44	3	3
Total	1641	100	100

Table 3.1 Water resources in major basins (FAO Water Reports 2008)

As mentioned by FAO Water Reports (2008), agriculture is the main water withdrawal sector, with 92.2% in 2004, municipal and industrial water withdrawal amount to 6.6% and 1.2% respectively (Figure 3.5).

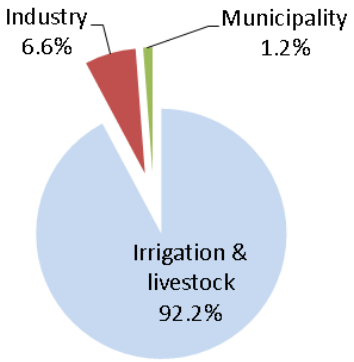

Figure 3.5 Iran agriculture, industry and domestic water consumption

(FAO Water Report 2008)

Groundwater abstraction (through wells, qanats and springs), varied from less than 20×10^9 m^3/year in the early 1970s, to over 74×10^9 m^3 /year at the beginning of the present millennium (Table 3.2) (FAO Water Reports 2008).

Basin	Wells (10^9 m^3/year)	Qanats (10^9 m^3/year)	Springs (10^9 m^3/year)	Total abstraction (10^9 m^3/year)
Caspian Sea	4.39	0.45	3	7.83
Persian Gulf and Gulf of Oman	10.08	1.06	15.24	26.38
Lake Oroomieh	1.97	0.23	0.12	2.32
Markazi	25.93	5.79	2.47	34.18
Lake Hamoon	0.8	0.4	0.06	1.26
Sarakhs	1.73	0.29	0.35	2.36
Total	44.89	8.23	21.24	74.35

Table 3.2 Groundwater abstraction in major basins

(FAO Water Reports 2008)

There are several large rivers that flow off the mountains on the slopes facing the Caspian Sea, the Persian Gulf and the Sea of Oman. The Karun River, flowing from the Zagros Mountains to the Arvand-Roud at Khorramshahr, is the country's only navigable river. All streams are seasonal and flow during heavy precipitation. There are 10 considerable lakes in the whole country, most have no outlet; they shrink through summer and have a high salt content (Mahdani-Larijani K 2005, Tavakolian 1997). Keshavarz et al (2005) mentioned that precipitation (rain and snow) is the main source of water in Iran. Total precipitation is estimated to be about 413×10^9 m^3 of which about 71.6 percent (295×10^9 m^3) directly evaporates. By taking into account 13×10^9 m^3 of water entering from the borders (joint border rivers), the total potential renewable water resources have been estimated to be 130×10^9 m^3 (Keshavarz et al 2005). Kashkuli et al (2011) stated that the total groundwater recharge is about 56×10^9 m^3. On the other hand, the total groundwater abstraction is about 74×10^9 m^3, causing a deficit of groundwater amount by 18×10^9 m^3. Mahmoudian (2003) highlighted that due to economic, technical, and environmental limitations, by the year 2020, Iran shall not be able to use more than 112×10^9 m^3 of either surface or ground water resources. According to the trend of population growth, the per capita renewable water has been reduced from 5,800 m^3 in 1956, to 1,830 m^3 in 1996, and is predicted to drop further to 1,200 m^3 by the year 2020. This means that the per capita renewable water will have decreased 5 fold from 1956 to 2020. (Mahmoudian 2003). Accordingly, Iran's annual renewable water availability, as highlighted by Mahdani-Larijani (2005) is now less than 2,000 m^3 per capita, and the country is facing water stress. With the current

population growth rate, Iran's annual renewable water availability will be reduced to 1,300 m^3 in 2021, and as stated by Mahmoudian (2003), the new generations will have to live with a limited amount of water.

3.5.2. Iran water management: past to the present

Water management in Iran could be defined in three stages of:

- Pre 1920s (ancient water management)
- 1920-80s (influence of modern water management)
- 1980-present (reform in water institutions and policies)

- **Pre 1920s (ancient water management)**

The importance of water in Iranian culture is highlighted by Ball (2003), that the first word in the Farsi dictionary is *"ab"*, which means water and its derivative, *"abadan"*, meaning civilized. As mentioned by Czarra (2002-2003), Iranians have a long history of managing water. Darius the Great King of Iran in 2500 B.C. exempted his subjects from taxes for many generations if people found sources of water. Since centuries ago with implementation of the river-bed treatments, diversion dams, construction of reservoir dams over rivers, and construction of more than 30,000 qanats, access was provided to attainable water resources. Qanat is an ancient water harvesting technique that is still being used in some small cities and rural areas in Iran (Figure 3.6).

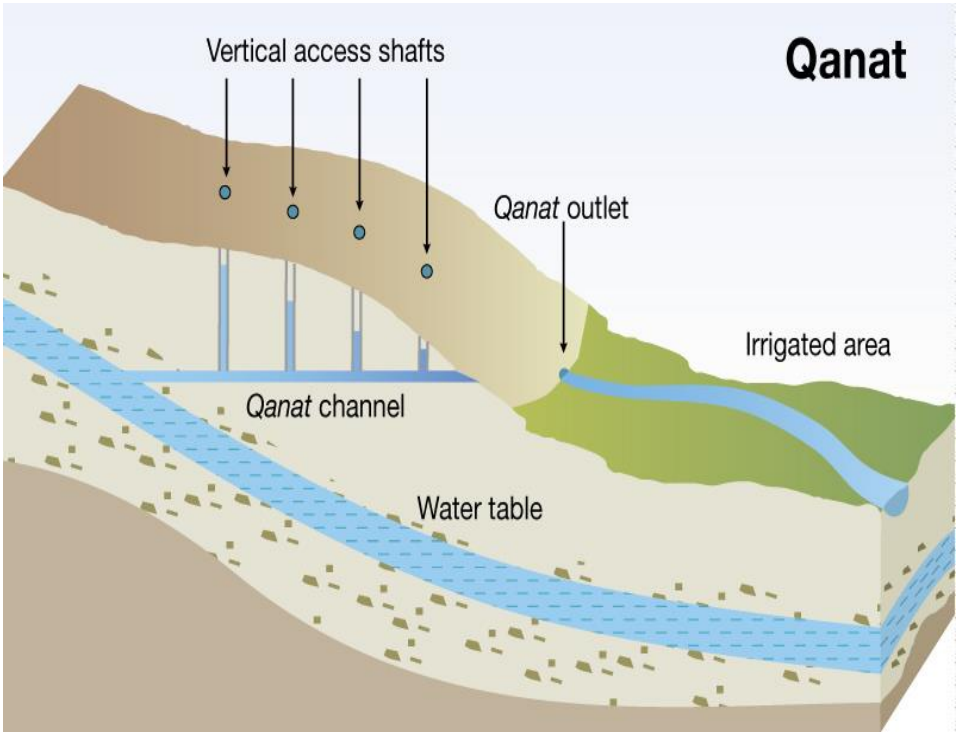

Figure 3.6 Cross-section of a qanat (Kaltenborn et al 2010)

As mentioned by Goldsmith and Hildyard (1984), qanats were first developed in Iran, and they are perhaps one of the most sophisticated systems of traditional irrigation known to humans. Chapin Metz (1987) highlighted that to make use of the limited amounts of water, the Iranians, centuries ago developed man-made underground water channels called qanat. They usually are located at the foot of a mountain and are limited to land with a slope. Most of the areas that qanats serve to irrigate are arid and rainless, and without qanats, agriculture in those regions would have been impossible. The most important advantages of the qanats are mentioned as prevention of evaporation, because it uses the underground location, and also it draws water located far from villages, rather than underground water resources (Chapin Metz 1987). As indicated by Global Engineering Alliance (GEA) Centre (2011), qanats ran for several kilometres and had vertical shafts at

20-30 metre intervals to provide ventilation, and access for repairs. The main tunnel would run down to an outlet in the village, where the water would be distributed to the fields via canals. An extremely advantageous characteristic of qanat is that the water in this system flows by gravity, and no other source of energy is used to deliver water to the points of use (Rahnemaei et al 2013). According to Hu et al (2012), the disadvantages of qanats make local people prefer pumping wells. These disadvantages could be mentioned as: limited water abstraction, high cost and great danger during maintenance, and waste of water in winter. Ghorbani (2007) mentioned that the technology of digging qanat is still traditional and qanat digging is a hard low income job, which can be life risking for diggers. Moreover, there is a high possibility of water contamination in qanats, especially when they pass through cities or villages. As indicated by United Nations (2004), in the past centuries, management of water resources in Iran was accomplished at the community level for qanats and rivers. Qanats were part of the Iranian culture, and still in some rural parts of Iran they are being used for providing the water. The management of the qanats was structured around interaction and communication between distribution managers and public. As stated by United Nations (2004) until recent years, the traditional regulations have been used to distribute water and the traditional regulations have been written as guidelines over the portal of the grand mosques, public squares and occasionally as portable hand written guidelines. In these handwritten guidelines *"Mirab"* (consists of *"Mir"*+*"ab"*, meaning "*the Lord of water*", was assigned as the water distribution manager and people, and/or villages were considered as the beneficiaries (United Nations 2004). Madani (2008)

indicated the qanats as the renewable water supply systems that have encouraged sustainable water use for eras. However, the socio-economic changes in the 20th century caused qanats to be put aside by the new water extracting methods, such as digging deep wells. And as stated by Balali et al (2009), the age of qanats or pre-modern water paradigm came to an end in Iran around the middle of the twentieth century. However, they highlighted that with growing risk of the water scarcity in the country, there is an interest in the rehabilitation of the qanat underground irrigation system, and its integration with modern water supply systems. They indicated such rehabilitation can lead to a significant drop in the reliance on deep wells (Balali et al 2009).

- **1920-80s (influence of the modern water management)**

The attention towards the modernisation of the water management started in the early years of the last century. According to Sunderland (1968), during the middle of the 20th century, Iran was mostly an agrarian country. In the sixties, the farmers of Iran were some three quarters of the country's population. Irrigation water was supplied through the springs, rivers, shallow wells and qanats, but the arrival of motor pumps significantly changed the picture (Rahnemaei et al 2013). As mentioned by Vali-Khodjeini (1995), until 1945 in Iran, groundwater was utilised by means of the qanats system, which provided about 75% of water used for irrigation. Balali et al (2009) mentioned that in the second half of the last century, supply-oriented water management was introduced into developing countries such as Iran, assuming that the building dams and pumping up groundwater flourish the region. Labbaf

Khaneiki (2007 cited in Balali et al 2009) highlighted that at the time, in order to pave the way for a modernisation, the Iranian authorities tried to deride the traditional water systems, and exaggerate the shortcomings of qanats to convince farmers to use pump extraction instead of qanat. As a consequence, water tables have been lowered, and a large number of qanats have become dry in areas with high population densities (Vali-Khodjeini 1995). To create the industrial modernity, the Iranian authorities tried to dismiss all traditional irrigation and production systems (Labbaf Khaneiki 2007 cited in Balali et al 2009). Construction of 58 big reservoirs and replacing the qanats by substituting of deep and semi-deep wells, were some of the results of the movement towards technical water management (Ardakanian 2005).

Ardakanian (2005) stated that the impacts of rapid urbanisation, led to an increase of domestic use of water, especially for hygienic purposes and the emergence of new needs for water due to expansion of cities, and promotion of life standards. Consequently, during this stage, new responsibilities have been created for water resources management. Ardakanian (2005) indicated that since the 1960s, government became more centralised, the political and administrative institution expanded, and the role of planning and budgeting became more obvious. Along with implementation and operation of projects on water securing, water supply for cities, irrigation and drainage networks, the contribution of the governmental sector in utilization system has been increased (Ardakanian 2005).

- **1980-present (reform in water institutions and policies)**

The necessity of reform in political and social systems became apparent since 1980. As indicated by United Nations (2004), the management of water resources has been carried out at the national level for overcoming the complexity of the water issues at the local, regional and national levels. In the national level, all the water issues are the Government's responsibility, and communities have been excluded from water management. Accordingly, people are not informed of water problems by the authorities, and they are not aware of the water situation in their country (United Nations 2004). As indicated by Rezapour (2011) in the past, natural water springs and groundwater resources did not belong to anyone, and people had the right to access the water by extraction of groundwater and surface water. Yet, now the water is considered as a national wealth, and different rules in the implementation of this policy are adopted. According to the approved water legislation in 1982, all surface water and groundwater belong to the public, and the Government is responsible for maintaining and monitoring the operation considering public ownership. Use of groundwater is under the Government, however, wells for drinking and household needs are allowed on condition that the amount of water removed does not exceed 25 m^3/ day (Tajrishy 2011, Rezapour 2011).

Mahmoudian (2004) mentioned that until 1990, water and wastewater related activities in Iran were carried out by provincial governments and municipalities. He mentioned this state of affairs caused many problems and difficulties related to clean water, and the sanitary discharge of wastewater for general use. Accordingly, it was decided that the management of the

national urban water and wastewater sector should be reformed to increase the involvement of the private sector. It was supposed that the private sector to be held responsible for the water services and production affairs, while the Government acts as a monitoring body, with a minimum of direct involvement for maximum quality. To this end, constant efforts were made towards the establishment of water and wastewater companies 'non-governmental and decentralized' in character, leading to the ratification of the Law for Establishment of Provincial Water and Wastewater Companies (PWW Co), in Parliament in 1990, marking a turning point in the country's water and wastewater management (Mahmoudian 2004).

As mentioned by Ardakanian (2005), currently there are different elements of policy makers, government, other organisations and the private sectors involved in Iranian water management. Policy making is based in the parliament and the Supreme Council. In the parliament, different committees on water, agriculture, natural resources, budgeting, and development, supervise management activities all across Iran. The Supreme Council of Water is chaired over by the President of Iran, and it supervises the collaboration and coordination between the associated ministries and organisations. All related organisations and ministries, as well as parliamentary representatives, are members of this Council (Ardakanian 2005). The main institution for water resources management is formed in the Ministry of Energy that is responsible for energy supplies and water resources, water supply, distribution, and conservation (Figure 3.7).

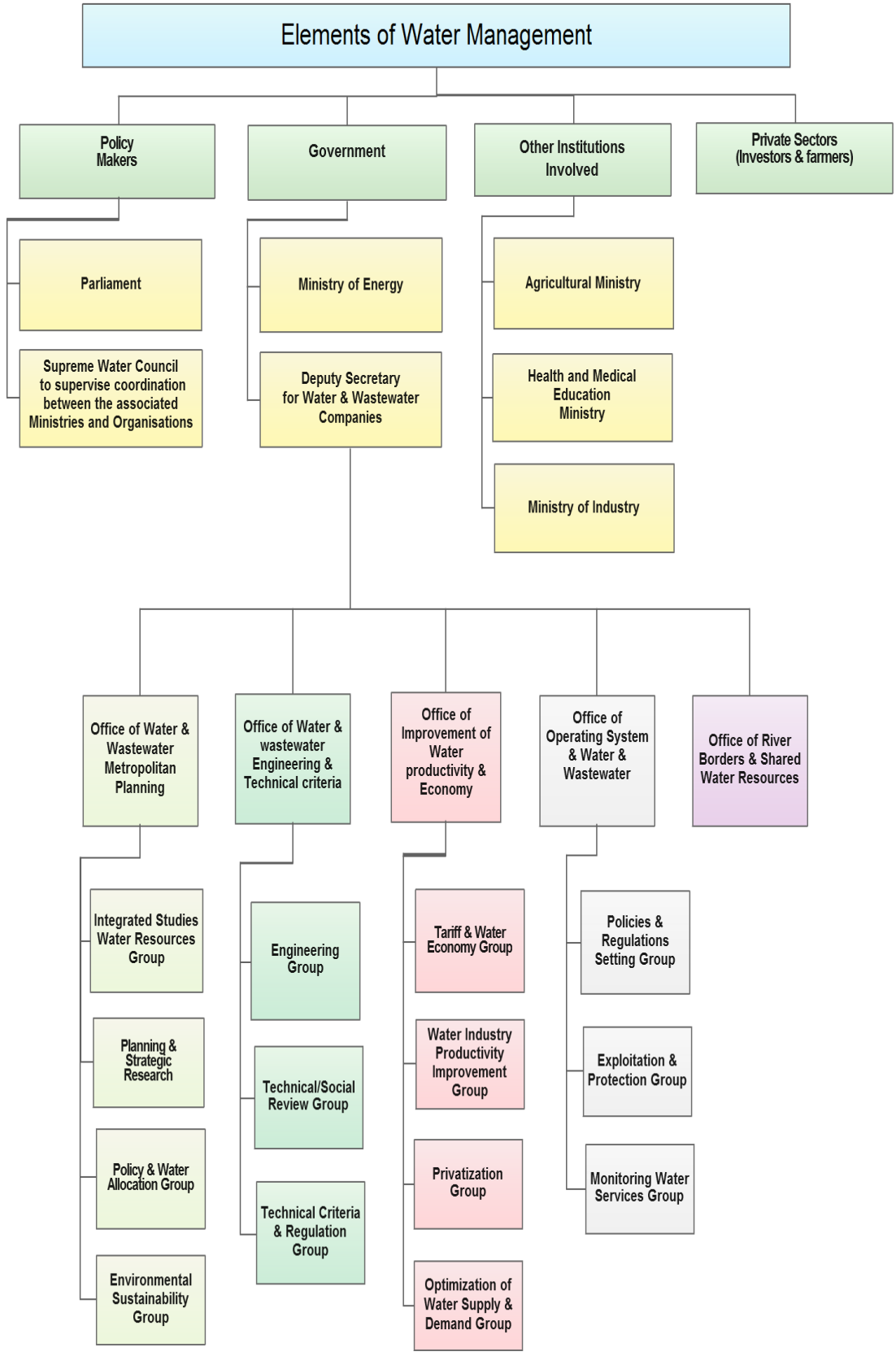

Figure 3.7 Current Iran water management elements

(TPWW Co 2013)

Other Ministries involved in water management are Agricultural Ministry and Health and Medical Education Ministry. Agricultural Ministry according to FAO Water Reports (2008), is responsible for supervising rain-fed and irrigated crop development. It is in charge of subsurface drains, tertiary and quaternary canals as well as farm development and irrigation techniques, planned and operated by the Provincial Agricultural Organisations, and the Deputy Ministry for Infrastructure Affairs of Agricultural Ministry. The Ministry of Health and Medical Education, according to United Nations (2004), is in charge of supervision and quality control of drinking water from the physical, chemical, biological and bacteriological aspects from its source to consumption points. Furthermore, consulting firms and construction companies support the above sections. The private sectors are included investors and farmers. As indicated by FAO Water Reports (2009), private sector is investing in water projects, especially irrigation, drainage systems and well drilling.

3.5.3. Main water challenges of Iran

The main factors that are causing the water problems in Iran could be mentioned as: progressive increase in population, migration and uneven population distribution, appearance of drought as a result of climate change, inefficiency in water irrigation systems, and excessive withdrawal of groundwater resources, (Mahdani-Larijani 2005, Ministry of Energy 2007). The population of Iran has increased around six fold during the last century, and the direct impact of population growth was a greater need for potable

water. Indirect impacts were the greater demands for agricultural products, and the more irrigated lands development (Jahani and Reyhani 2006).

The climate change impacts on the water resources of Iran were studied by Abbaspour et al (2009). The result of their study indicated more frequent and larger-intensity floods in the wet regions, and more long droughts in the dry regions during the period of 1980 to 2002. Their study mentioned heavy rains in 2001 in some parts of Iran that claimed hundreds of lives and caused a lot of financial damages. Their research also highlighted the fifty villages in central Iran that were abandoned due to the drought in 2001 (Abbaspour et al 2009). The use of groundwater in the past 40 years has always been on the increase, which is the result of the reduction of rainfall in the country (Ministry of Energy 2012). As stated by the Deputy of Ministry of Energy (cited in Iran Economist 2013), Iran's rainfall amount is reduced to 75% of normal rainfall.

For overcoming the country's water problems, as mentioned by Mahmoudian (2004), the Government of Iran has included various strategies in the national water management programs. These strategies are: efficient and optimal use of available water resources; continuing effort to find new resources in the water cycle, maximum use of unconventional water, deep and far-reaching action to conserve freshwater resources, prevent the pollution and destruction of water quality, expanding public awareness and implementing demand management programs. Furthermore, the continuing water shortage in the country has forced many decision-making bodies to consider the reuse of wastewater as an option, such as implementation of general plans for recycling water (Mahmoudian 2004). Considering the continued water problems in Iran, it seems that these strategies were not implemented

effectively. Mahdani-Larijani (2005) described how supply-focused water management is the main barrier to overcome the water related challenges in Iran. For example water planners counteract the challenge of providing the high-populated cities with massive dam construction and more piping (Mahdani-Larijani 2005).

3.6. Greater Tehran context

Tehran, the capital of Iran, is one of the largest and most populated cities of the world. According to Mahmoudi (2006), Tehran is experiencing perhaps the fastest urban development of all Asian cities. Greater Tehran has accommodated almost 20 percent of the country's population, constituting the largest population base in Iran (Mahmoudi 2006). Tehran, originally a small city of about 200,000 people has been the country's capital city for over 200 years. Figure 3.8 shows the historical growth of Tehran.

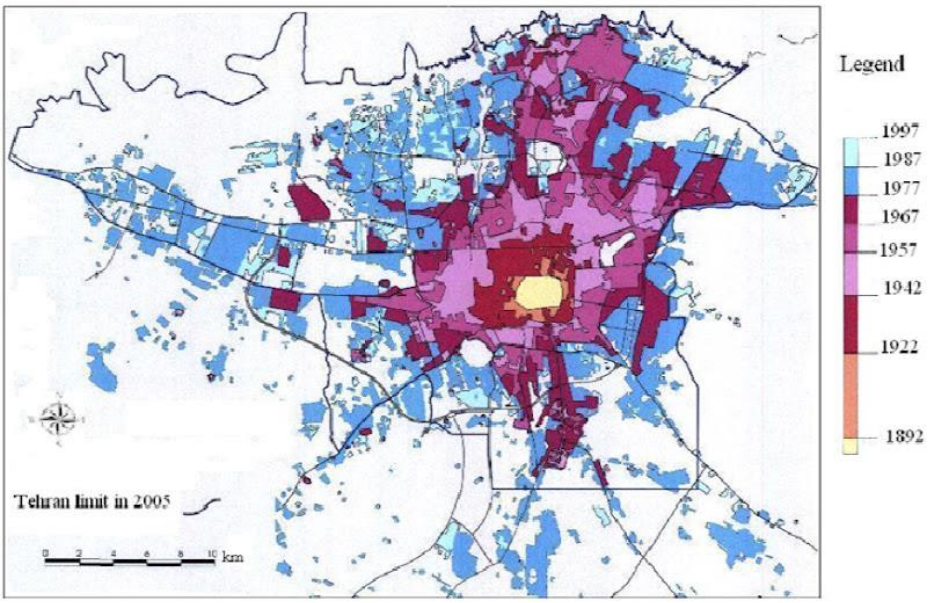

Figure 3.8 Historical growth of Tehran from 1892 to 1997

Zanganeh (2006, cited in Roshan et al 2009 p 315)

According to the recorded census, the population of Greater Tehran and its regions have rapidly grown and now has a population more than 12 million (Table 3.3).

Name	Census 1986	Census 1991	Census 1996	Census 2006	Census 2011
Iran	49,445,010	55,837,163	60,055,488	70,495,782	75,149,669
Greater Tehran	6,042,584	6,475,527	6,758,845	11,345,375	12,183,391

Table 3.3 Population of Iran and Greater Tehran

(Statistical Centre of Iran 2012)

3.6.1. Water demand

Mahmoudi (2006) indicated that in 1963, the water supply volume for Tehran was around 300×10^6 m^3 which was 30% more than demand. In 1993, supply and demand reached equilibrium, but from 1996 a shortage has appeared. It is therefore predicted that by 2021, water demand will have reached 1400×10^6 m^3/year; this means 480×10^6 m^3 more water will be needed (Mahmoudi 2006). Table 3.4 shows statistics related to the year of 2009 regarding Tehran water production and harvesting from surface and groundwater, and also the water use of the city. As can be seen in the Table, the total water use (980.73×10^6 m^3) is close to the water production (1017.22×10^6 m^3), however, the statistics do not indicate the water use for the different sectors for water users.

Month	Production and harvesting of surface and groundwater		Total (10^6 m^3)	The amount of water used for each month (10^6 m^3)
	Surface water resources (10^6 m^3)	Groundwater (10^6 m^3)		
January	40.82	37.39	78.21	75.62
February	44.41	38.15	82.56	79.92
March	59.40	21.48	80.88	77.33
April	55.05	33.29	88.34	84.53
May	55.76	36.84	92.60	89.05
Jun	56.58	37.55	94.13	90.94
July	57.35	37.21	94.56	91.03
August	52.75	38.74	91.49	88.15
September	44.33	38.73	83.06	79.89
October	41.10	36.42	77.52	75.79
November	39.36	36.98	76.34	73.75
December	40.69	36.84	77.53	74.73
Total	**587.60**	**429.62**	**1017.22**	**980.73**

Table 3.4 Surface/groundwater production and water use year of 2009

(Atlas of megacity of Tehran 2012)

As highlighted by Mokhtari (2013) currently, 11 provinces in Iran have less than 1700 m^3/capita/year renewable water and by 2025, renewable water per capita/year for the country will decrease to 1530 m^3/capita/year and 13 provinces will have water crisis including Tehran province. In Tehran the water demand is putting a great pressure on the water supply of the city. As there is no clear data on the water consumption of different sectors in the city of Tehran, the different views are being stated. Some authors suggested that the domestic water consumption in Tehran is the highest form of water usage in the city. Bidhendi et al (2008) indicated the household consumers account for 70% of the total water consumption of the city. Some other authors stated that the water consumption of the city of Tehran is related to different sectors of household, urban agricultural, industrial and parks. As indicated by Abdolghafoorian et al (2011), the city has about 20 km^2 of parks and they are

been irrigated by fresh water even though many of them are located close to wastewater treatment plants. In addition their study indicated that water efficiency in the industrial sector is very low. The industries located in south and western parts of the city, have the potential to replace the potable water demand with reclaimed wastewater for their landscape irrigation (Abdolghafoorian et al 2011). Collectively, Greater Tehran with having dry climate, constant population growth and a low rate of renewable resources per capita is subjected to water shortage (Khalili 2012).

3.6.2. Tehran water resources

Water is supplied to Tehran from both surface and groundwater resources. Bagheri and Hjorth (2007) defined that the water supply system of Tehran relies on the water storage in Karaj, Latyan and Lar reservoirs as well as Tehran aquifers (Figure 3.9).

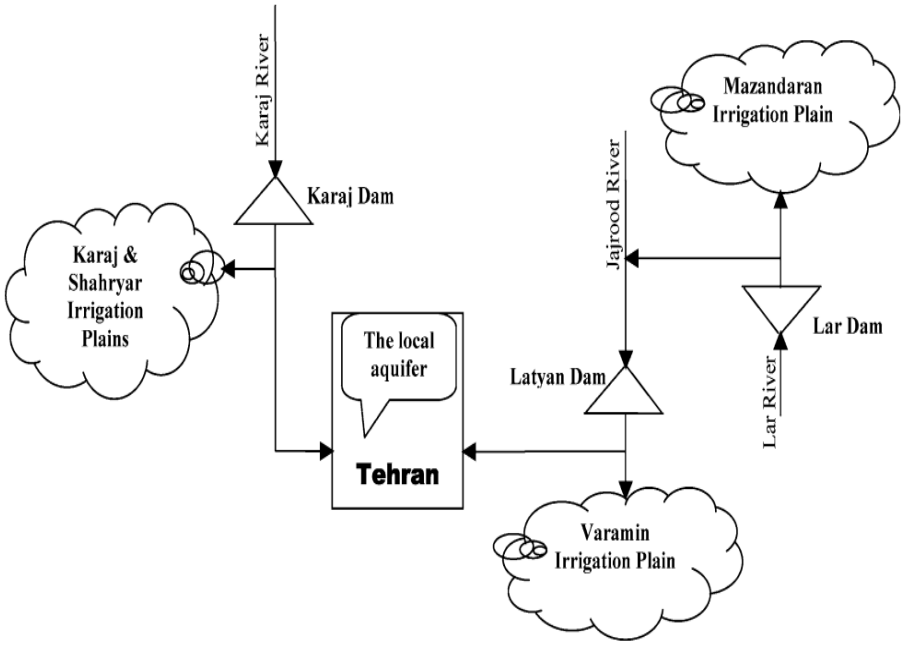

Figure 3.9 Tehran water resources (Bagheri and Hjorth 2007)

Table 3.5 shows the distribution of water supply through surface water and groundwater from 1975 to 2000. A total of 540×10^6 m^3/year of water supply of Tehran are provided by Dams of Karaj, Latyan and Lar by the year of 2000. The Table indicates that there is an increase in the groundwater proportion in water supply of Tehran during the years 1975 to 2000.

		1975		1985		1995		2000	
Sources		%	10^6 m^3/year	%	10^6 m^3/year	%	10^6 m^3/year	%	10^6 m^3/year
Surface water	Karaj Dam	60	212	57	310	43	320	29	270
	Layan & Lar Dams	30	108	33	180	36	290	29	270
Groundwater		10	35	10	55	21	170	42	390
Total		100	355	100	545	100	810	100	930

Table 3.5 Surface water and groundwater proportion for Tehran

(Tajrishy and Abrishamchi 2005)

3.6.3. Surface water resources

Mahmoudi (2006) indicated that Tehran is not constructed close to any large river; thus its water resources are very limited. The city is dependent on the water support from the other cities and areas. The present surface water resources as can be seen in Figure 3.10 are: Karaj River in the western mountains, Jajrood River in east part of the area, and Lar River in the north-eastern mountains. Surface water supplies have been augmented by the construction of the Karaj Dam on the Karaj River, the duplication of the original aqueduct, and the construction of the Latyan Dam and tunnel

diverting water from the Jajrood River east of the city. The Lar Dam is constructed on the Lar River.

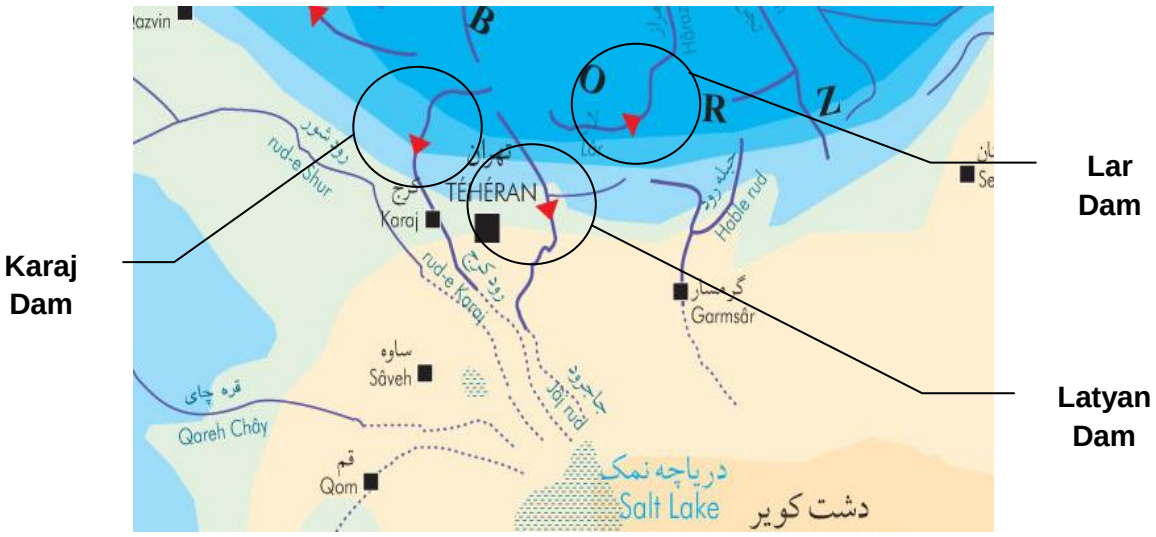

Figure 3.10 Geographical locations of Tehran water resources

(Tehran Municipality 2011)

Jahani and Reyhani (2006) indicated two more water resources of Taleghan Dam on River Shahroud (west of Tehran area), and Mamlo Dam on River Jajrood (east of Tehran area), are to supply water to the city to meet future water requirements of the city, with the capacity of supply of 150 and 80 million m^3/year, respectively. The Mamlo dam is located 45 kilometres east of Tehran and is set to provide water for agricultural objectives in southern towns of Pakdasht and Varamin, and drinking water for more than one million people in south of Tehran, and came into operation for agricultural purposes in 2008 (Iran Daily 2011). Taleghan dam is located 120 kilometres to the northwest of Tehran to supply a portion of drinking water for the capital's citizens, along with the Qazvin plateau, Taleghan dam was constructed on

Shahroud River. Construction process commenced in January 2002 and terminated in January 2006 (Taleghan Dam News 2012).

Asadilour et al (2012) stated that the five dams of Karaj, Latyan, Lar, Taleghan and Mamlu only supply approximately 72% of demands in current condition. In 2006, the surface water resources supplied Tehran domestic with 705×10^6 m^3/per year, while a further 250×10^6 m^3/year were pumped from 200 deep wells with an average depth of 130 m to water supply network. This indicates the important role of groundwater in supplement of the remaining domestic demands.

3.6.4. Groundwater resources

In addition to the surface water, the groundwater is supplied to Tehran. Golmehr (2012) stated that consuming of groundwater has increased rapidly since 1993 to manage the increasing demand of water supply in Tehran. Excessive expansion of groundwater has been developed by means of deep and shallow wells (Table 3.6). The Table shows the existing available data about groundwater wells, 6,222 of deep wells and 9,313 of shallow wells have been excavated in Tehran and its surrounding regions (Golmehr 2012).

	Number of wells		
	Deep	Shallow	Total
Tehran city	2374	6825	9199
Tehran surrounding regions	3848	2488	6336
Total	6222	9313	15535

Table 3.6 Number of wells in Tehran and its surrounding regions

Greater Tehran is located to the north of the central plateau of Iran on the southern slopes of Alborz Mountain (Tajrishy and Abrishamchi 2005). The general direction of groundwater flow in the area is from northern Alborz piedmont zone towards the southern deserts in Varamin area (Jahani and Reyhani 2006). The depth of water table in Tehran varies from 100 m in the north, and around 5 m in some areas in the south. Especially in Rey area (south of Tehran), the water table is almost close to the surface and continuous pumping operations are performed to lower the water table (Jahani and Reyhani 2006). Groundwater exploitation is also providing water to green fields and other parks and public gardens all over the city.

Khakbazan Fard et al (2012) indicated that Varamin Plain is located on the south-east of Tehran province with desert climate. The forty-year average annual precipitation (1967 to 2007) of the plain has been recorded as 131 mm. According to TPWW Co (2013), currently, Varamin's water company (SEW Co) supplies the area's water by 127 active wells. Due to the Varamin plain situation (being flat), practically it is not possible to use gravity to move water, and currently the SEW Company, in order to store the drinking water and balance the water pressure in the distribution network, uses storage tanks and pumping stations. Khakbazan Fard et al (2012) mentioned that Varamin plain water demand includes agricultural, industrial and urban demand. They indicated that industrial and urban sectors use only groundwater resources. However, the agricultural sector uses the surface water discharged by the wastewater Company of Tehran for the purpose of irrigating fields and farmland located in Varamin (Bigdeli and Seilsepour 2008).

3.6.5. Qanats

According to Jahani and Reyhani (2006), up to the year 1927, water was supplied to Tehran through 26 qanats with a total discharge of 700 l/s. According to National Water and Wastewater Engineering Company (2013), the first plan on Iran water piping was in the year of 1951 for 900 thousand people of Tehran, by constructing the first drinking water pipe network. Before construction of drinking water pipeline network, city's residents were provided with the most basic methods of water harvesting through qanats. Those qanats were taking water from far away to where people lived, and after going through a long path finally reached to the public or houses ab-anbars (water storage). From the year 1952 onwards in Tehran, Water Piping Commission was established to pipe the qanats water into the city. At that time there was no indoor water supply equipment, and there were taps on the pipes in the public areas that people could access the water. Later, with the development of financial and technical resources, water piping transferred into the houses. In 1958, Water Piping Commission was registered formally in a number of charity organisations (National Water and Wastewater Engineering Company 2013). Since 1960, Tehran water resources changed from qanats to using surface water and over the time its citizens were supplied by constructing the dams and getting water from the nearby cities. In 1963, the Karaj Dam and Tehran aquifer were added to the city water supply alternatives Jahani and Reyhani (2006).

According to Tehran Municipality (2013), the current scope of Tehran shows that the city has hundreds of kilometres of canals related to the qanats with multiple paths. Although some 500 qanats in Tehran and its suburbs are

known, the total number is much higher. While qanats are 130 metres below the surface in some parts of the city, in many places their depth is less than 2 to 3 metres (Tehran Municipality 2013). During the water management modernisation, the qanat that was compatible and adaptive for the region have been ignored and forgotten by the water managers. The current situation of Greater Tehran qanats highlights that due to the expansion of urban areas and the lack of organisational responsibility, most of the qanats in Greater Tehran have been abandoned and degraded, and in some cases have been distorted or blocked. As indicated by Jahannews (2010), due to the irregular construction of new properties a lot of qanats have been destroyed and they are not operational. The report highlighted that even in one of the top universities of the country many people are unaware of the existence of qanats in their University. The University of Tehran qanats are dying due to problems such as collapsing, misappropriation, pollution and waste. There are incidents around Greater Tehran involving the qanats, some of which are reported by the newspapers. According to the Iran newspaper (2007), one of the old qanats in Varamin was collapsing because of the proximity to the railway vibration and the impact of the sewage. The qanat had created a deep subterranean cavity that was causing cracking and subsidence of land adjacent to the wet walls of nearby houses.

3.6.6. Current water price policy

Water price setting is the current policy of Tehran water management as a national policy appointed by the government. As stated by Mahmoudi (2005), the costs of supply, transfer, treatment, distribution and monitoring of water in

Tehran are too much. As mentioned by Bagheri and Hjorth (2007), the water tariffs did not cover the water services costs. Figure 3.11 illustrates the gaps between the water tariff and the cost of water services during 1996 to 2004 in city (Bagheri and Hjorth 2007).

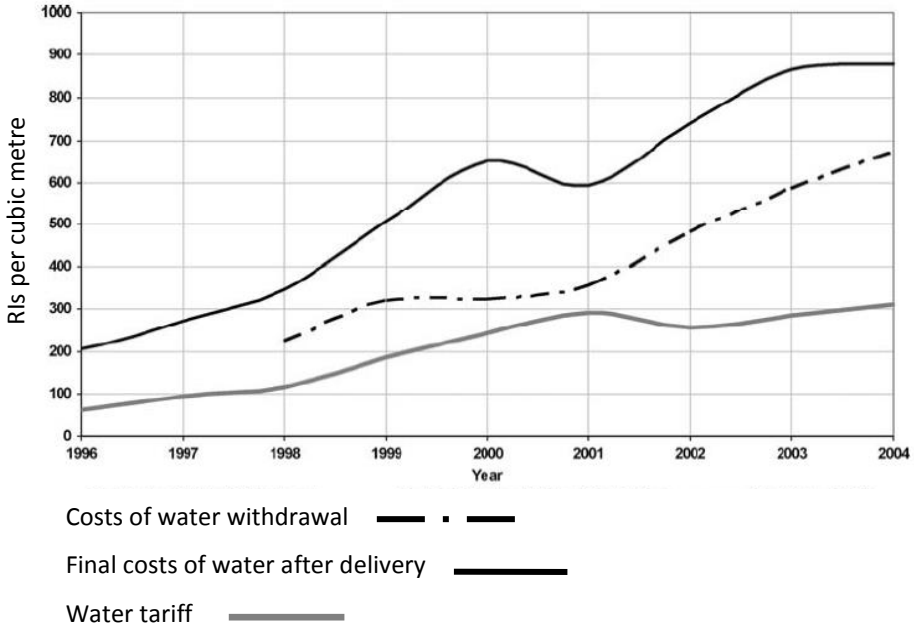

Figure 3.11 The gaps between costs and water tariff in Tehran (Bagheri and Hjorth 2007)

The gap between cost of water production and the water tariff could be rooted in the policy of subsidies in Iran. There is a long record of subsidies in Iran to keep the prices of commodities or services low. These subsidies were applied towards the sections of energies such as fuel and electricity, food, and also water. Esen Gonen (2011) indicated that history of subsidies in Iran goes back to the 1970s, when high inflation rates and price instability, particularly in the fossil-fuel products, caused government to establish Consumers Support Fund with a view to controlling prices and distributing

subsidies. As a result, while Iran was among the most energy-efficient countries in 1980s, it is now one of the most wasteful (Esen Gonen 2011). As mentioned by Global Subsidies Initiative (2011) in December 2010, Iran launched a program to slash energy, food and water subsidies, in an attempt to rein in unnecessary budgetary spending and eliminate waste. Government is authorized to determine the water price considering the full cost of water supply, transmission and distribution with respect to the geographical areas, types and levels of consumption using progressive block tariffs. In five years, the water price is intended to be equivalent of the full cost of the production. Average prices would be determined for the various uses considering the water quality and how it is produced. The water price is the one of the basic consumer goods which is going through a lot of changes in Greater Tehran, as well as in the whole of Iran (TPWW Co 2011).

As pointed out by Rogers et al (2002), consumers and suppliers of water have different expectations of water tariffs. Consumers like high quality water at an affordable and stable price. Suppliers like to cover all costs and have a stable revenue base. Considering this matter, the effectiveness of the policy could be a question. How can state policy of cutting the water subsidy bring water consumers and water authorities together to help the water companies recover water production cost alongside the water conservation? Do the water companies in Tehran know their consumers? Is increasing the water price affordable for all social groups? It appears that confronting the water crisis in Tehran requires some changes of values from decision makers as well as people such as identifying cultural and social factors.

3.7. Chapter summary

The Chapter presented key findings from the literature review related to the water availability, with focus on developing countries. Reviewing the literature indicated the great concern for the future of water availability in developing countries due to the climate change and population increase. The Chapter indicated that there is a desire in developing countries to depart from supply-oriented approaches. The Chapter presented a review of Iran water management and its challenges during the last century. The population increase and the people's life style change pushed the water managers towards seeking more water supplies and constructions. The result was the domination of the technical side of the water management. The review also highlighted that the existing water supply management in Iran is not capable of addressing the current and future water problems in a sustainable way.It is predicted that in the near future, Greater Tehran water availability will be only 100 m^3 /capita/year (Mokhtari 2013), and evidently, some areas of Greater Tehran such as Varamin currently suffer from water shortage as water resources are decreasing so fast. Could the supply oriented water management of Iran go towards AWM? Could this help the country to solve its current challenges and get ready for uncertainties of the future? For answering these questions the research aimed to investigate the extent to which the concept of Adaptive Water Management is suitable for application in Iran. The next Chapter presents research aim and objectives and discusses the research methodology for addressing the research objectives regarding the adaptability.

Chapter 4

Research design and methodology

4.1. Introduction

This Chapter is concerned with the research design and methodology choice which affected the process and outcomes of this research. The Chapter identifies a case study on the basis of data collection from the semi-structured interviews to establish the knowledge required for the conceptual framework of AWM. The Chapter presents the research aim and objectives, the research approach, the data requirements and the sampling techniques through which the data was collected and analysed.

4.2. Research aim and objectives

This Thesis is intended to examine AWM within the water management policies and also evaluate AWM social values among water consumers in Greater Tehran. As shown in Figure 4.1, the research aim could be indicated as:

"To evaluate the extent to which the principles of Adaptive Water Management could be adopted in Greater Tehran"

In order to achieve this aim, the following objectives were identified:

1. To investigate the water management challenges facing Greater Tehran and to examine how these challenges are being addressed in terms of policies and implementation.

2. To explore the extent to which current water policies and practices can be described as ‘adaptive’.
3. To examine the feasibility and barriers to using Adaptive Water Management for the future management of water in Greater Tehran.
4. To draw conclusions about the extent to which Adaptive Water Management is suitable for application in other cities in the Middle East region.

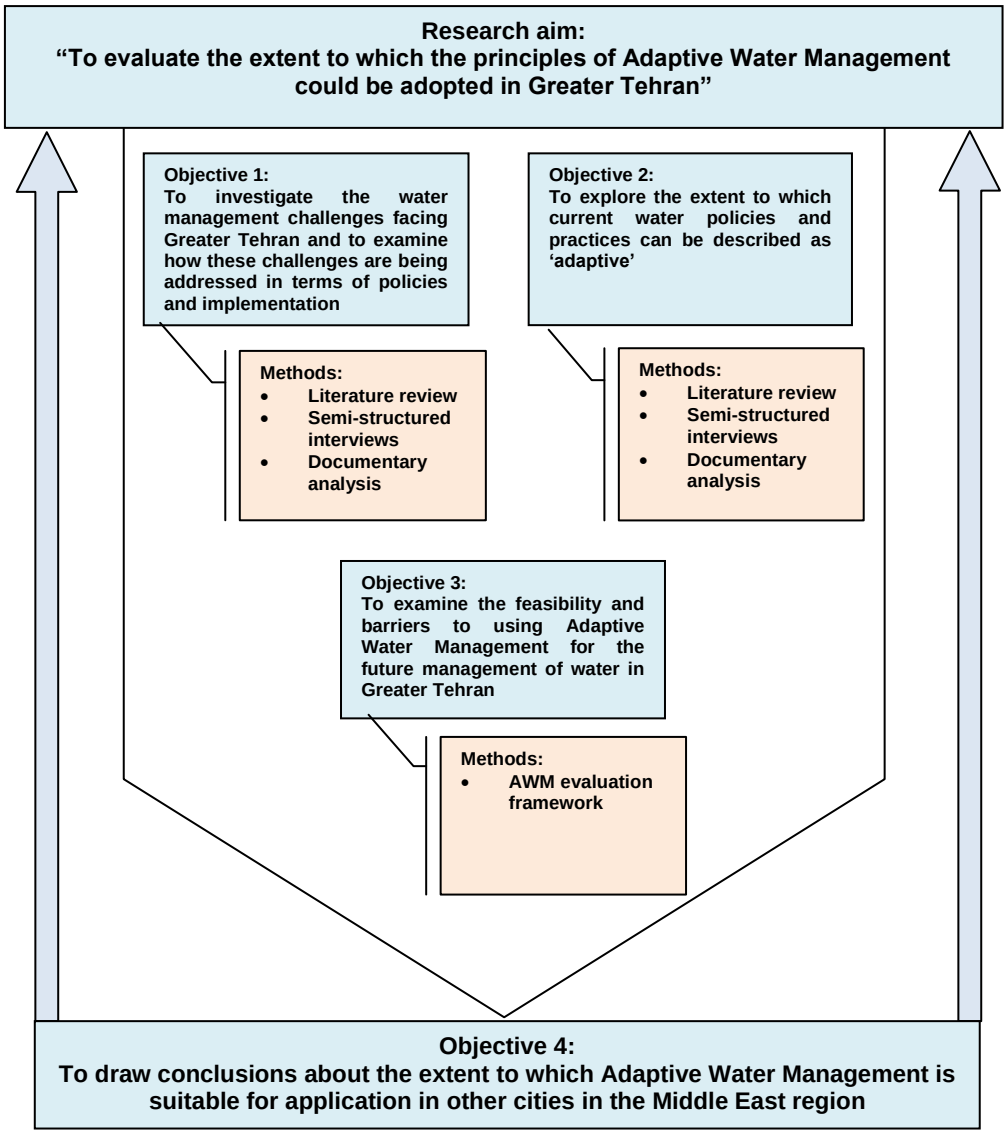

Figure 4.1 Aim, objectives and methods of the research

The research elements related to the objective 1 were to build knowledge on the Greater Tehran's water companies, explaining the challenges they are facing and how the challenges are addressed. The research elements related to objectives 2 and 3 were to build the knowledge in three areas. First, the study explored the characteristics of polycentric governance, institutional flexibility and public participation. Second, it investigated the AWM characteristics within the selected water companies in Tehran province and their water consumers. Thirdly, the research examined the applicability of AWM in Greater Tehran. Data was collected from both companies and their water consumers. Regarding the companies, the process of the decision making, leadership, and the interactions with other organisations and the public were examined. The public views on the water policies and their attitude towards participation in water management were investigated.

4.3. Research approach, purpose and logic

This study adopted a largely qualitative approach. The reasons for this choice can be referred to the research objectives that are concerned with the understanding of real world intangible processes, and values that are not easily quantified. The research objectives seek to investigate water management challenges, the extent of water policies' adaptability, and also the feasibility and barriers to using AWM within an urban context. AWM emphasises the need for water companies to work with the public, and for this reason both water companies and the public are seen as relevant sources of data. Considering the research objectives, a qualitative research is a suitable strategy for understanding the real world.

Collis and Hussey (2003) indicated four different types of research purposes which are exploratory, descriptive, explanatory and predictive. They mentioned that an exploratory research tries to explore, discover and bring to the light the research questions. The aim of exploratory research is to look for pattern and typical techniques used in this type of study include case studies, observation and historical analysis which can provide both quantitative and qualitative data. Collis and Hussey (2003) highlighted that the descriptive research seeks to gather and summarise the information, and describes phenomenon as they exist. They indicated that an explanatory research is a continuation of descriptive research, and intend to understand causal relations. The predictive research aims to generalise from the analysis by predicting certain phenomena on the basis of hypothesised, general relationship, and predict what might happen in various scenarios (Collis and Hussey 2003). Considering the above definitions of the different types of research propose, this research can be seen as an exploratory research, because it tries to focus on gaining insights into research objectives through a case study to assess whether the concept of AWM is a suitable application for Greater Tehran.

For conducting appropriate methodology it is also important to identify the logic of the research. As indicated by Trochim (2006), research reasoning has two broad methods, known as inductive and deductive. In an inductive approach, as stated by Blackstone (2012), the researcher moves from specific, to the general by collecting relevant data. It is mentioned that after gathering a substantial amount of data, the researcher tries to look for, and explaining the patterns (Blackstone 2012). The data is therefore used to

generate theory. In contrast, deductive reasoning works from the more general, to the more specific (Blackstone 2012). A deductive approach initiates with a precise or predetermined structure and then uses that structure for data analysis (Williams et al 2004). Haider and Birley (1999) specified the use of previous research is an advantage for the deductive method. However, they mentioned that this method has the disadvantages of testing only “whether or not” or “to what extent”. In addition, the research richness of data can be lost if a conversation with a respondent develops in an unstructured way (Haider and Birley 1999).

This research seems to be deductive research as it commences with a predetermined framework of AWM. The literature review as discussed in Chapter 2 provided a conceptual framework of AWM (Figure 4.2 p86) which was considered for investigation of the extent of adaptability in Greater Tehran. However, as indicated by Williams et al (2004), in reality most qualitative researches involve a combination of both inductive and deductive approaches. Thus, this research could be also including the inductive element by further adjustments and developments to AWM framework. The findings of the research will lead to AWM conceptual framework development.

4.4. Research design

The research design consisted of three stages: literature review, case study and the evaluation of the AWM framework.

First stage: literature review

The first stage involved the literature review that highlighted the water management changes during last few decades, with introducing the AWM as a sustainable alternative approach. This review collected the data that helped to address the research objectives, and also helped to build a framework for evaluating the AWM characteristics through Greater Tehran water companies and water consumers.

The study reviewed the literature related to the 'water availability', 'climate change', 'water management', 'WSM', 'WDM', 'IWRM', 'sustainability', 'adaptability', 'SUWM', 'developing countries water management', 'water management in Iran and Tehran. These reviews were taken for two reasons. First, as described in Chapter 1 p6, there has been limited focused research on AWM. Consequently, the other bodies of literature were used to justify the research problem and identify the factors related to the AWM characteristics. Secondly, the scope of research was of the water companies in the developing countries, accordingly, the literature of water management in developing countries. Iran and Tehran were reviewed because they were directly related to the research objectives. For example, to address research objective 1, an examination of water challenges were required to be reviewed. Some of the reviewed literature has already been discussed in Chapters 2 and 3, but other elements of the reviewed literature will be discussed in the following Chapters. This stage helped to provide a conceptual framework of AWM for this research (Figure 4.2). This conceptual framework led the research to investigate the Greater Tehran water management regarding the three main characteristics of the polycentric

governance, institutional flexibility, and public participation (see Chapter 2 p25).

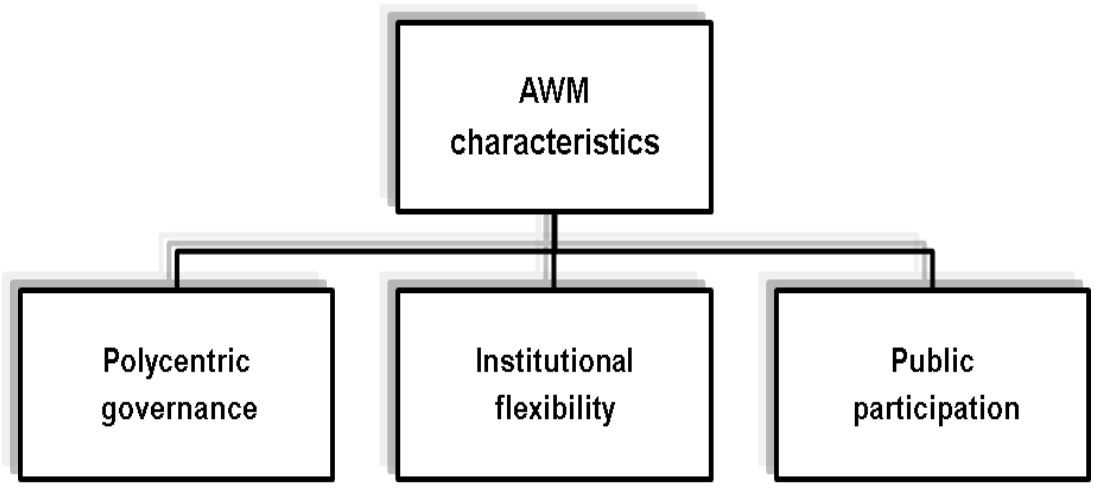

Figure 4.2 Conceptual framework of the study

Second stage: case study

The second stage involved a case study that included two water companies of Tehran Water and Wastewater (TWW), and South-East Water (SEW), and their consumers. In order to address the research objectives, primary data was needed to be collected in Greater Tehran through the semi-structured interview with water industry professionals, and with members of the public. As indicated by David and Sutton (2004), semi-structured interview refers to a context with prearranged questions, but, the interviewer is able to change the order of questions and to ask additional questions in response to what are seen as significant replies. Table 4.1 illustrates the linkages between the research objectives and the data collection methods.

Research objectives	**Data collection methods**
Objective 1: To investigate the water management challenges facing Greater Tehran and to examine how these challenges are being addressed in terms of policies and implementation	Literature review of academic papers, journals, government publication, newspapers that involved: • Different approaches of the water resource management (WSM, WDM, IWRM) • Developing countries water management • Iran and Tehran water management Case study that involved: • Two water companies. There were 14 semi-structured interviews in total over the two companies. The interviews involved water professionals who played different roles in the companies. • Two cities of Tehran and Varamin water consumers. There were 28 semi-structured interviews in total. The interviews involved the water consumers with different socio-economic levels
Objective 2: To explore the extent to which current water policies and practices can be described as 'adaptive'	Literature review that involved: • Water management approaches • Iran and Tehran water management • Literature review that involved the AWM Document analysis for TPWW Company to gather additional related data Case study (as previously described under objective 1)
Objective 3: To examine the feasibility and barriers to using AWM for the future management of water in Tehran	• Reflections on the outcomes of the AWM characteristics in Chapters 5, 6 and 7. • To conclude whether AWM characteristics could be applied in Tehran water management. And Do AWM characteristics make any difference in Tehran water management?
Objective 4: To draw conclusions about the extent to which Adaptive Water Management is suitable for application in other cities in the Middle East region	• To conclude whether AWM characteristics could be applied in other developing countries, and whether AWM makes any difference in developing countries water management.

Table 4.1 Research objectives and data collection methods connections

Table 4.2 presents the AWM characteristics, the source of data, and the collection methods that were used for each characteristic. The three characteristics of AWM in Table 4.2 show the methods of data collection and the target sampling (companies and public). For the characteristic of the polycentric governance, data related to the institutional governance was gathered from the companies. Institutional flexibility characteristic involved gathering data on the institutional process within the companies. Concerning the characteristic of public participation, data was collected from companies and public that was related to the interaction between companies and the water consumers. The interview questions are presented in Tables 4.5 (p101) and 4.8 (p108).

AWM Characteristics	**Data source**	**Methods of data collection**
Polycentric governance	Data from water professionals on : • the decision making process in their companies • their companies' relationships with external organisation	• Semi-structured interview with professionals • Documentary analysis • Governmental publication • Questionnaire
Social flexibility	Data from water professional on the • main water challenges and what their companies were doing to address those challenges • internal management of the companies	• Semi-structured interview with professionals
Public participation	Data from water professional on • their views on the public role in the company's current practices and strategies. Data from water consumers on • their involvement in their city's water management	• Semi-structured interview with professionals • Semi-structured interview with water consumers

Table 4.2 Evaluation framework of AWM

Third stage: evaluation of AWM framework

The third stage of the research is involved with the evaluation of the AWM framework. For this reseach, a conceptual model was created, bringing together and refining the research findings that contribute to the emergence of AWM characteristics in the water management of Greater Tehran (Figure 4.3). As shown, the features that have been included in this model represent the AWM charactristics of polycentric governance, institutional flexibility and public participation. As mentioned in Chapter 3 p67, the water management in Iran is mainly supply-focused. Accordingly, as outlined in Figure 4.3, the left side of the continuum in the model indicates the dominant WSM. As the study aims to explore the adaptability of the water management in Greater Tehran, the right side of the continuum indicates the AWM. This model tries to represent the findings of the study regarding the AWM characteristics (see Table 2.2 p33).

First, the model indicates the information about the water companies' governance. As outlined in the proposed model, the water governance of the companies is investigated by the companies' decision making process, and companies' interactions with external organisations. The outcomes of the investigation provide the information regarding the adaptability of companies' water governance.

Second, the model highlights the institutional process of companies. As indicated in the model, the institutional flexibility of companies is investigated by how companies respond to their challenges (technical and institutional), and also by identifying the level of interactions between different levels in

companies. The outcomes could indicate how adaptive companies are regarding institutional flexibility (see Table 2.2 p33).

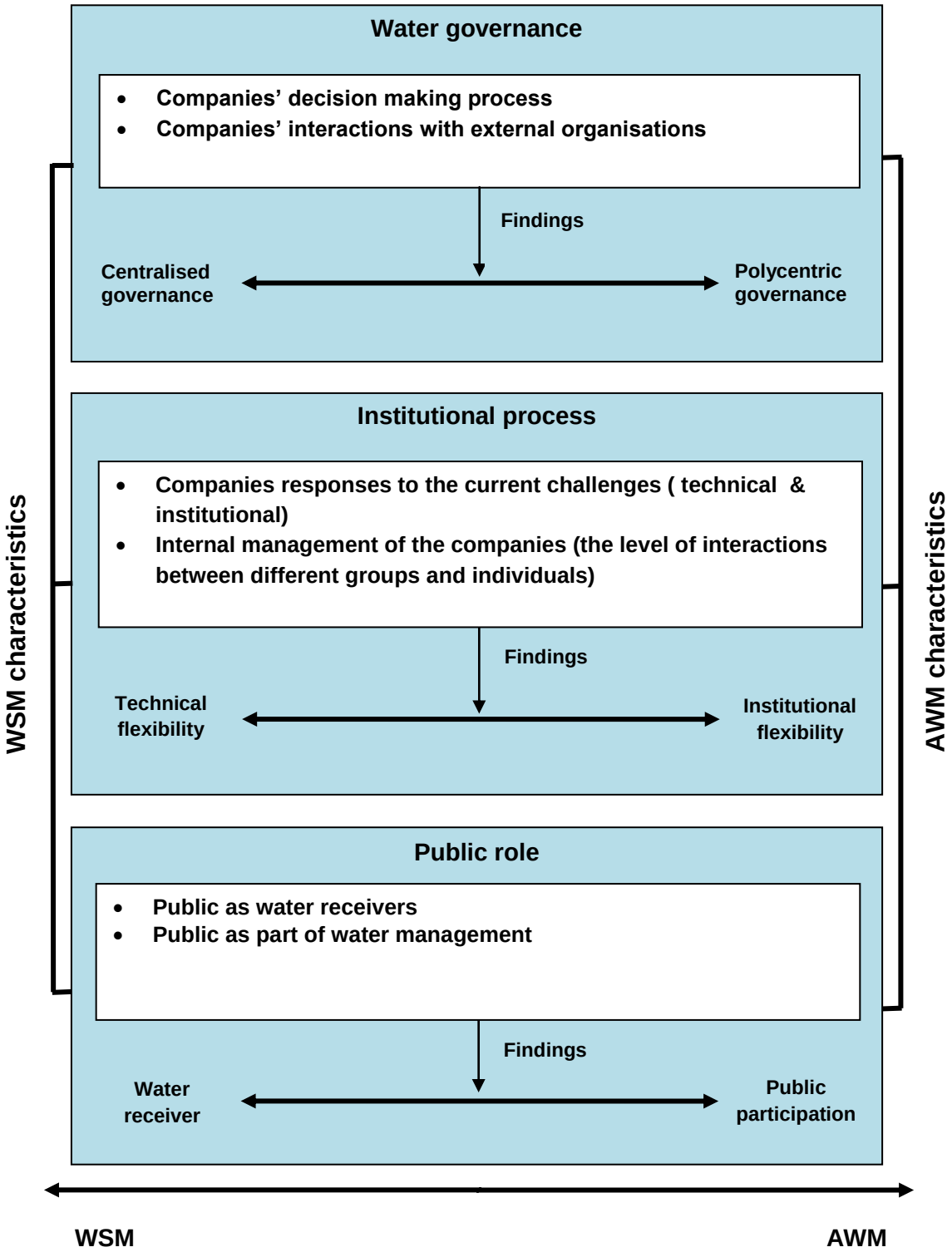

Figure 4.3 A conceptual model that contributes to the emergence of AWM

Third, the model shows the public role in Tehran water management by examining water companies' perspectives. How companies see the public role in water management: water receivers or a part of water management. The outcomes highlight the adaptability of companies regarding the characteristic of the public participation. Furthermore, the water consumers' perspectives regarding their city's water management are evaluated by investigating their views on received information, water price, water practices, personal values, the degree of trust of authorities, and involvement in water management. This investigation is likely to show the public connection with their water companies, and their willingness to take part in their cities' water management.

4.5. Data collection methodology

4.5.1. Literature review

Data collection began with the analysing the current situation of water resources availability, water scarcity in the world and developing countries, and water challenges of the developing countries with focus on the water management in Iran. This was followed by reviewing the main water approaches of WSM, WDM, and IWRM. The relevant literature review and documentary analysis of the AWM and Tehran water management were the main focus of this research. The review identified the relevant journals and conference papers, books and official reports. The literature review was a three year process, accordingly the new related literatures were being examined throughout the study. The documentary analysis was undertaken to understand the surrounding context of the case study. The water

companies' policies and the companies' governance arrangements were gathered from interviewees and the water companies' websites.

4.5.2. Case study

The case study as indicated by Zaidah (2007) enables the researcher to closely examine the data within a specific context, and explores in progress, real life events through analysis of a number of conditions and their relations (Zaidah 2007). As indicated in Chapter 3, the Middle East is one of the most water scarce regions in the world. With continued climate change and urbanisation, these countries will face a decline of per capita annual renewable water resources to 500 m^3 by the year 2025 (Office for the Coordination of Humanitarian Affairs (OCHA) 2010, Global Environment Outlook 2007; World Bank 2013). As mentioned earlier in Chapter 1, Iran is among the countries in the Middle East region with high fresh water loss. As can be seen in Figure 1.1 (p2), two of Iran's neighbouring countries, Turkey and Iraq show the similar decline in their water storage after a regional drought in 2007. Table 4.3 compares some of the national figures of Iran with these two neighbouring countries. As can be seen in the Table, these countries might be expected to exhibit similar properties in relation to water management. For example, similarly to Iran, they have high populated capital cities, high freshwater withdrawal in the agricultural sector and the similar water challenge of decrease in the freshwater water availability per capita. These similar characteristics mean that the conclusions that are drawn from the Tehran case study might be reasonably assumed to provide an indication

of the sorts of issues which would be faced if apply AWM to water management in large cities in these countries.

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	Iran	**Turkey**	**Iraq**
Urban population	69.1% of total population (2011)	71.5% of total population (2011)	66.5% of total population (2011)
Capital population	Tehran 7.304 million	Ankara 4.194 million	Baghdad 6.036 million
GDP per capita	$12,800 (2013 est.)	$15,300 (2013 est.)	$7,100 (2013 est.)
Total renewable water resources	1.37×10^{11} (2011)	2.12×10^{11} (2011)	8.99×10^{10} (2011)
Freshwater withdrawal (domestic/industrial/ agricultural)	Total: 9.33×10^{10}/year (7%/1%/92%) Per capita: 1.31×10^{3}/year (2004)	Total: 4.01×10^{10}/year (14%/10%/76%) Per capita: 5.73×10^{2}/year (2008)	Total: 6.60×10^{10}/year (7%/15%/79%) Per capita: 2.62×10^{3}/year (2000)

Table 4.3 Iran, Turkey and Iraq in the Middle East region

(Central Intelligence Agency 2014)

The case study examined the potential gaps between current water management practices and the AWM application for a better understanding of the AWM, and to recognise whether the application is suitable to be practiced in water management of Greater Tehran. The case study is selected with a full consideration of accessibility of information, time demands, language, cultural consideration, and financial expense for the researcher.

4.5.3. Data collection from water companies

4.5.3.1. Purposive sampling of companies

Purposive form of sampling as indicated by Saunders *et al* (2009), is often used when working with very small samples, such as in case study research and when researchers wish to select cases that are particularly informative. In this study, the research was purposive in focusing on two specific water companies in Greater Tehran. The objectives were to examine the current water management challenges, and to understand the extent of the water companies' adaptability in Greater Tehran. Considering these objectives, water companies of Tehran, were considered as the sample for this research. Figure 4.4 shows the areas of the case study in Greater Tehran that are the cities of Tehran and Varamin.

Figure 4.4 Greater Tehran

The process of selection involved obtaining a mixture of water companies varying in size and covered area of Greater Tehran. The sample of the study consisted of two water companies (TWW and SEW) of TPWW Company. These two companies provided a suitable setting for study for investigating the water management in Greater Tehran upon the size and the covered area. These companies belong to two sharply contrasting parts of Greater Tehran. One (TWW) is responsible for the city of Tehran with almost 8 million population, mostly middle class. While the other one (SEW) is responsible for the city of Varamin, with a considerably smaller population of around 600 thousand that are mostly working class. While the city of Tehran has access to both surface and ground water resources, SEW company is providing people of Varamin with ground water from wells because there is no access to surface water. Currently, the city is suffering from water shortage as water resources are decreasing so fast. This choice of contrast was to examine in depth the type of problems experienced in Greater Tehran.

TWW Company

The biggest company of TPWW Co is TWW, which includes six subsidiary companies. In 2010, approximately 8.1 million people were covered by this company. The TWW Co is responsible for water and wastewater services within the city of Tehran. Table 4.4 illustrates the company's subsidiaries with population coverage. Figure 4.5 shows the area covered by this company.

Tehran Province Water and Wastewater Company (TPWW Co)	
Tehran Water and Wastewater Company (TWW Co)	
Subsidiary companies	Population cover
Region 1	1450000
Region 2	1763000
Region 3	1967800
Region 4	1500000
Region 5	1700000
Region 6	1850000

Table 4.4 TWW Company's subsidiaries

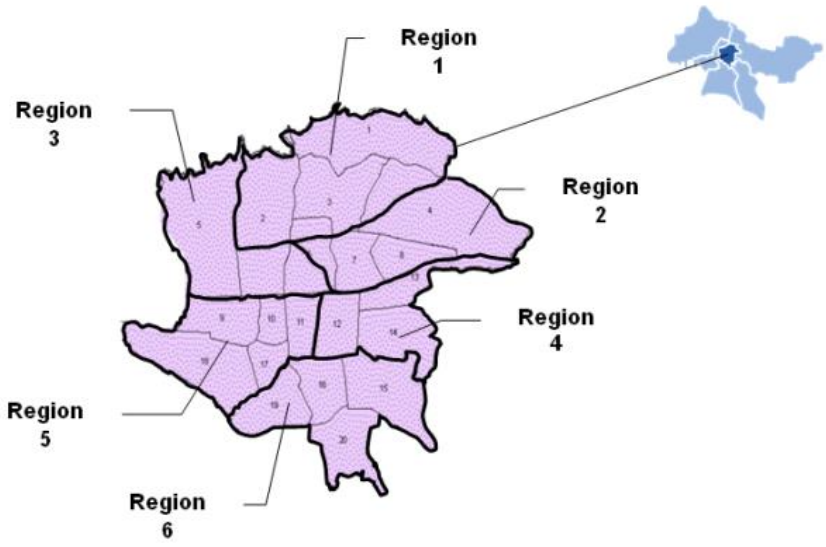

Figure 4.5 Covered areas of the city of Tehran by TWW Company

SEW Company

The SEW Company is responsible for the city of Varamin, which is located in the south-east of Greater Tehran. The SEW Company is responsible for water supply and water drainage in the city of Varamin and its towns with the coverage population of approximately 637800. Figure 4.6 shows the area

covered by SEW Co, and also the sampling areas of the study in the city of Varamin.

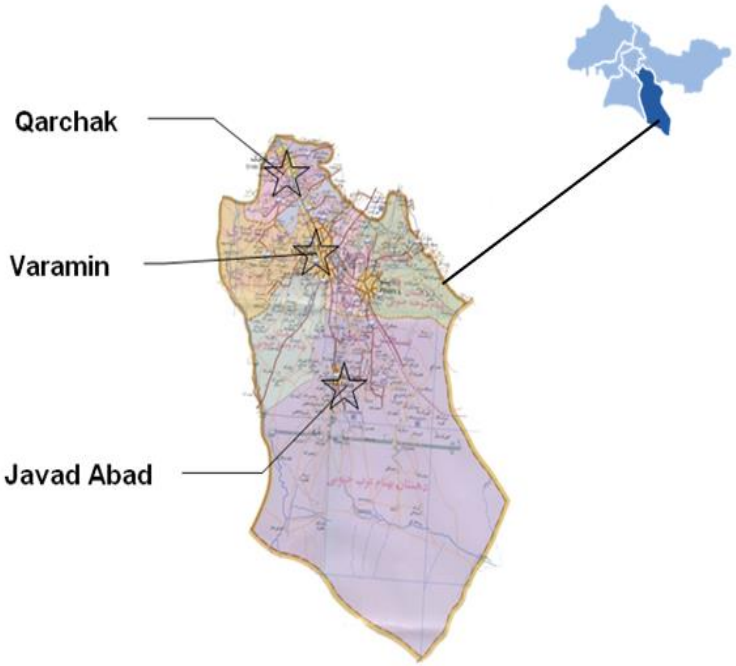

Figure 4.6 Covered areas by SEW Company & Varamin sampling areas

4.5.3.2. Purposive and snowball sampling of professionals

A method of non-probability sampling was decided for collecting data from the water professionals in this research. According to Saunders et al (2003), the non-probability sampling provides a range of alternative techniques based on research subjective judgment. This sampling technique provides the researchers with an information rich case study in which they explore their research question (Saunders et al 2003). In this study, the water companies' managers and professionals in Greater Tehran were considered as the potential research population. The purposive sampling was selected for the interview because the target participants were required to have

knowledge of the topic investigated. In this case water professionals who were working for Tehran Provincial Water and Wastewater Company (TPWW Co). Thus, the interview process involved the selection of water company professionals who were more likely to know about water management applications, and who could provide the researcher with the information which was needed for the research.

In order to limit the time taken in identifying potential participants, snowball sampling was also employed within the companies. Snowball sampling is a technique for finding people with particular knowledge for the research. As indicated by Vogt (1999), one subject gives the researcher the name of another subject, who in turn provides the name of a third, and so on. This research used this technique in the water companies to find the people with the knowledge of water management within the organisation. However, as indicated by Saunders et al (2003), a risk could be that the process identified potential respondents who are similar to themselves. In this research, this risk was minimised through being selective of sample interviewees based on their responsibilities in the organisation. The professionals working in the offices of water monitoring and productivity, water quality control, energy and consumption management, budget and planning were the target for taking the samples. Chapter 6 provides more details on professionals' organisational responsibilities.

4.5.3.3. Access to companies

The first step was getting permission from the TWW Company's head to access their employees. Prior to my interviews, I had a meeting in person

with the head of the Company explaining my research area in water management, and why the research was important and how it could be beneficial for their company as well as the city. I was lucky enough to be able to secure this interview through existing contacts in Tehran. I asked him to refer me to the people in the company who were most appropriate for my particular research. Therefore, I was introduced to the head of the monitoring and productivity department of TWW Company to start my interviews. The next step was to ensure the willingness of the target individuals to participate in the research. This was done by arranging a personal visit, explaining my research aim and how they could help me in my research, and asking their permission for the interview. I provided the interviewees with an information sheet (Section 4.6.1 p109, Appendix C and C1) that gave the participants an idea of the research by answering the questions that may be asked by them. The interviews took place mainly in the participants' offices. However, I was flexible, and if the respondents felt more comfortable, we would carry out the interview somewhere else. Each interview was face to face, and before starting the interviews a signed consent form (Section 4.6.1 p109, Appendix C and C1) was given to the participants to emphasis the confidentiality of the interview, anonymity of participants and their company. I had 14 semi-structured interviews with the TWW (8 interviews) and SEW (6 interviews) professionals who were working in the different offices of the companies. All interviews took place in participants' offices considering their willingness.

4.5.3.4. Interview question design

The purpose of undertaking the semi-structured interviews with water professionals was to gather the information about the current policies and strategies of Tehran, and to investigate the attitude towards AWM among water professionals. The interview was designed into two main parts. The first part of the interview included the closed questions and participants were required to answer the questions by a short sentence or by selecting the answers from a list. This part consisted of 9 questions (see Appendix A and A1), and was intended to collect general information from the organisation and participants, and also to gather the information about Tehran and Varamin's current water policies and strategies. The second part contained the open questions; in this part of the interview participants were mostly in control of the conversation. The questions of this section were designed considering the AWM characteristics of polycentric governance, institutional flexibility and public participation (Table 4.5).

Within the characteristic of the polycentric governance, the questions were intended to determine whether the water governance of the organisation is centralised, or decentralised, and also to discover the level of interaction in the organisation externally. Considering the characteristic of institutional flexibility, the questions were intended to highlight the different water strategies in the region for understanding the adaptability of the strategies and how they could adjust to the changing situations. In addition, the level of interaction within the companies was examined. Regarding the characteristic of public participation, questions aimed to highlight the interactions between the organisation and the public. Finally, the participants were given the

opportunity to state their comments regarding water management in Greater Tehran and the interview.

AWM characteristics	Interview open questions
Polycentric governance	• I would like to understand more about decision making in your organisation. Can you pick an example of an initiative or investment which has been made recently that you can tell me about? • What is the initiative or investment? • Who took the decision to undertake this initiative/ investment? • How did the initiative / investment relate to the central government's policies and perspectives? Did someone in Government know about it – or is it something that the company can just go ahead and do by itself? • Did the decision involve interaction with other organisations – if so, which, and what form did the interaction take? How did the initiative change as a consequence?
Institutional flexibility	• What do you see as the main risk, threat or concern which Tehran's water system is facing? Can you explain what your company is doing to address this threat? • If you had extra financial resources to invest in Tehran's water management, what would you see as the priority areas for investment? • Who in the company contributed to the decision?
Public Participation	• Did the initiative involve interaction with your customers? If yes, what form did this interaction take? How did the initiative change as a consequence?

Table 4.5 Water professional open questions

4.5.4. Data collection from water consumers

4.5.4.1. Quota sampling

In this study, the objectives behind interviewing water consumers were to examine their relationship with water companies. Considering these objectives, water consumers that were covered by two water companies, TWW and SEW, were the sampling target. In this study a method of non-probability quota sampling was selected to collect data from the water consumers. As indicated by Fox et al (2007), quota sampling is a form of non-random technique in which the sample is designed to meet certain quotas by age, gender and social class and the sample selected within each quota is selected by convenience, rather than random methods (Fox et al 2007). Quota sampling has some advantages over the probability sampling techniques such as being very quick, less costly, and it does not require a sampling frame, and therefore may be the only technique the research can use if one is not available (Saunders et al 2012). However, according to Saunders et al (2012), the quota sampling is subject to bias as the choice of group sampling depends on the researcher. However in this study, the risk of bias was minimised through accessing reasonably heterogeneous groups using the variables of age, gender and socio-economic status. Dennis (2005) mentioned that in the quota sampling, age and gender are signified to control variables. He indicated the importance of having appropriate control variables because quota sampling has the disadvantage of some participants being easier to find than others (Dennis 2005).

4.5.4.2. Sampling frame and size

According to the knowledge of the researcher, the whole population of Greater Tehran are provided drinking water throughout the water piping system. The quota sampling attempts to investigate the water consumers regarding their relationship with water companies, and their opinions on their roles in water management. Water consumers of two companies, TWW and SEW were the target population of this research. For the purpose of TWW customers, the samples were taken from the north and south of the city of Tehran that are covered by two sub-companies of region 1 and 6 of TWW Company respectively (Figure 4.7).

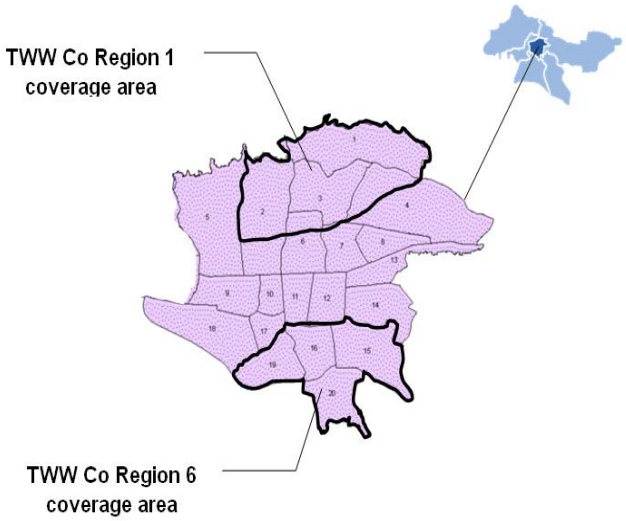

Figure 4.7 Sampling areas for water consumers (Tehran, TWW)

Considering SEW Company, the population of the three main towns had been selected for the samplings which were: Qarchak, Varamin and Javad Abad (Figure 4.6). Overall, people living in region 1 on Figure 4.7 are wealthier than the residents in other areas (Figures 4.6 and 4.7). These two sharply contrasting parts of Greater Tehran provided a suitable setting for

study regarding the socioeconomic variable. While the majority of the population of Varamin are of a working class background, Tehran's population is representing the middle class people. These particular groups of the population allowed the study to investigate different socioeconomic status, alongside of two quota control variables of age and gender.

Overall, the research processed a total of 28 semi-structured interviews that were undertaken from the public in the city of Tehran (16 interviews) and Varamin (12 interviews). As indicated by Statistical Centre of Iran (2012), more than 60% of the population of Iran are under the age of 30. Accordingly, the strategy with respect to the age variable was to have two interviews under the age of 30 in each group of four interviews (half from the age of 18-30). Table 4.6 shows the ideal and achieved quota sampling concerning the age variable. Regarding the gender variable, research was attempted to have half of each gender in each group of the four interviews.

		Ideal quota sample		Sample achieved	
		Under 30	Over 30	Under 30	Over 30
TWW Co	Region 1	2	2	3	7
	Region 6	2	2	4	2
	Total	4	4	7	9
SEW Co	Qarchak	2	2	0	3
	Varamin	2	2	3	2
	Javad Abad	2	2	2	2
	Total	6	6	5	7
Total		10	10	12	16
		20		28	

Table 4.6 Ideal and achieved sampling related to age variable

The variable of gender (male and female) was chosen because it was highly reasonable to expect that the researcher tended to select the samples of the same gender (female). Therefore, the sampling included the general

population structure of both male and female. Table 4.7 shows the ideal and achieved quota sampling concerning the gender variable. Although, there is a slight preponderance of female respondents, the bias due to this was not thought likely to influence the conclusions substantially as the results (Chapter 6) did not show major differences between respondents of the two genders.

		Ideal quota sample		Sample achieved	
		Male	Female	Male	Female
TWW Co	Region 1	2	2	3	7
	Region 6	2	2	2	4
	Total	4	4	5	11
SEW Co	Qarchak	2	2	2	1
	Varamin	2	2	3	2
	Javad Abad	2	2	2	2
	Total	6	6	7	5
Total		10	10	12	16
		20		28	

Table 4.7 Ideal and achieved sampling related to gender variable

4.5.4.3. Access to water consumers

The study was intended to interview the population in the areas covered by two water companies, TWW and SEW. The community organisations such as mosques and colleges were selected as target places for recruiting the participants. The strategy was repeated across the five selected areas of the cities of Tehran and Varamin. The procedure used was as follows:

1. Gaining permission from the head of each community place (imam of the mosque or head of the college).
2. I distributed an information sheet explaining the research subject to potential respondents, asking them if they were willing to fill in a

questionnaire. The main purpose of the questionnaire was to initiate a conversation about water which led to the interviews.

3. I gave the questionnaire to the participants who agreed, and then I collected it back and answered any questions.
4. At the end of the questionnaire I asked the respondents if they were willing to have an additional interview with me.
5. Of those who agree to a potential further interview, I selected from the volunteers considering factors of gender (half male, half female) and age (half under 30, half over 30).
6. The interviews were arranged in a location chosen by the participants. This was sometimes their community organisation, or sometimes somewhere more comfortable for them, for example their home.

It should be noted that some 'bias' is unavoidable because not every resident chooses to use community facilities, and not all such facilities can be reached. Nevertheless, in the context of an environment in which I have no sampling frame, the strategy appears to able to reach a significant variety of respondents.

4.5.4.4. Interview questions design

The intention of the semi-structured interviews with water consumers was to collect the information on the water consumers' point of view about water companies and water services, and especially to highlight people's experiences and attitudes towards the water policies. The interview involved answering a questionnaire and open questions. The questionnaire consisted

of 13 closed questions that were quick to answer for the respondents (see Appendix B and B1). The questionnaire contained standard demographic questions as well as questions related to the respondents' view and opinions about the current water price policy (water price). The questions were compressed into one page. The respondents were instructed to answer questions:

Please tick in the appropriate box or explain in a short sentence

At the end of the questionnaire the respondents were required to indicate if they were willing to have a further interview with researcher:

You've answered the first part of the research questions do you wish to consider taking part in an additional interview? Yes No

And finally an expression of gratitude was made as:

Thank you for your time and kind cooperation

The open questions gave the respondents the opportunity to speak more freely in their own words. The questions were aimed to investigate the level of interactions between the public and the water companies, and how people see their role in the city's water management. After finishing the interviews, the respondents had the opportunity to express their comments. Table 4.8 shows the open questions of the interview.

It should be noted that regarding the water consumers' interview questions, a pilot study was undertaken. The aim of the pilot study was to check the questions' clarity for the participants and the time of the interview completion.

The pilot interviews were undertaken with the water consumers in the city of Tehran. In this pilot, when respondents were observed to complete the questionnaire, they were asked to identify any lack of clarity regarding the questions. Their feedback was considered to adjust and improve, and also to modify some of the questions regarding the questionnaire and the open questions. Some questions were dropped and some were added or changed. As the result, a final version was prepared for the actual interviews (see Appendices B and B1).

AWM characteristics	**Interview open questions**
Public Participation	• What are the main ways of using water in your home? • Did you ever try to minimize your water use? How and why would you do that? • Have you ever used any water saving devices (such as a low flow kitchen water tap device) in your house? If no would you like to use them? Why/why not? • There is waste water in each house; do you have any idea for reusing the waste water in your house? If it were possible; would you consider practicing your idea? • What is your opinion about using recycled water? If it was available would you consider using it? Why / why not? • Did you receive any information about the way they manage water from your water company? If yes could you tell me what was it and what you learnt from it? Was the information just right / too much / too little for you? • Have you ever noticed any public information program in media or received any education from authorities on water? If yes what did they say? If yes, how has seeing/receiving it affected you? • If you had the opportunity to make a suggestion to your water company, what would it be? How you would do that? • What is your opinion on water price? Did the water price increase change your way of water use? Why/why not? • Is there anything that you want to mention in relation to the water management of Tehran?

Table 4.8 Water consumers' open questions

4.6. Research ethical issues

The procedures for the data collection were agreed and developed in advance of the fieldwork through interaction with the University of Bradford's social science ethics committee. The research took place in my home city of Tehran and the city of Varamin. Interviews were undertaken by the researcher in offices, homes, or in semi-public locations, such as mosques.

Before starting the interview, informed consent (Appendices C, C1, D and D1) was provided to the participants. The informed consent process consisted of an information sheet and a consent form. The informed consent process was designed for water professionals (Appendices C, C1) and water consumers (Appendices D, D1) separately.

4.6.1. Informed consent

The information sheet gave the participants the information they needed to know regarding the research and their participation in the interview, and the consent form gave them the assurance and guarantee of anonymity and confidentiality for taking part in the research. The participants were given a copy of the full informed consent.

Information sheet: the information sheet provided the participants the information related to the study by giving a brief idea of the research purpose and answering the key questions that may be asked by them. The information sheet started with an introduction about the researcher and the study and invited the participants to take part in the study:

> "I am a PhD student and I am doing research on the water management in Tehran. I am going to give you the information and invite you to be part of this research..."

The purpose of the study was explained in simple language, and the information sheet also clarified why the participants have been chosen for the study for both groups of the water professionals and the water consumers:

> "You are being invited to take part in this research because we feel that your experience as a water professional can contribute much to our understanding and knowledge of Tehran water management."
>
> Or
>
> "You are being invited to take part in this research because we feel that you as a water consumer can contribute to our understanding and knowledge of Tehran water issues."

The information sheet highlighted that the participation was completely voluntary and the participants could disengage from the research at any time:

> "It is up to you to decide whether or not to take part. The choice that you make will have no bearing on your job or on any work-related evaluations or reports. You may change your mind later and stop participating even if you agreed earlier without giving a reason."

The information sheet also states that all the information related to the participants was handled in confidence with pseudonyms instead of their real names. The participants were provided by special phone number and the email address which were created for research purposes only:

> "All information that is collected about you during the course of the research will be handled in confidence. We will not be sharing information about you to anyone outside of the research team. The information that we collect from this research project will be kept private. Any information about you will have a pseudonym on it instead of your name. Only the researchers will know what your pseudonym is and we will lock that information up with a lock and key. It will not be shared with or given to anyone."

Consent form: this section included a brief statement about the research signed by the researcher. In the situation that participants (water consumers) were not literate, I followed a verbal consent procedure by reading the consent form aloud. The consent form included statements as follows:

- Taking part in the interview is completely up to your decision, and you are free to withdraw your consent at any time before the data analysis begins.
- The researcher will be ready to answer correctly and to the best of her ability any questions related to the study to participate.
- All data collected during the interview (notes, audio recording) will be kept anonymous.
- Your name and the name of your company will remain anonymous.
- You will not be subject to any influence, pressure or inducement.

- You are free to discontinue participation at any time you wish, and data collected from those interviews will not be considered for research and will be destroyed.
- The audio files and notes will be destroyed once they have been transcribed and the analysis completed. The transcripts and analysis records can then be kept for 10 years.

4.6.2. Interview process

At the beginning of each interview, the assurance of anonymity and confidentiality was repeated. The length of the interviews were different from each other (from 30 minutes to 1 ½ hour). The researcher got the consent of the respondents for using a recorder for the interview, and if they were uncomfortable about using the recorder, note taking was used. The participants were assured that there would not be any record of their name, their companies, or anything directly related to them on the tape or researcher notes. The recording tape did not start until after the person's name had been obtained. I promised that if there was something that was mentioned by one of the interviewees that when quoted might identify that person, I would check with her/him whether I could put it in my thesis. Each interview was saved in a separate file. The filename did not compromise confidentiality and preserved the anonymity of each person in a way which can only be recognised by the researcher. A separate backup of data files was stored on a USB which was kept in a locked place. Filenames for each transcript involved allocating a pseudonym to each interviewee that had no link to his/her real name. A record of this allocated pseudonym alongside the

interviewees' names was kept in a password protected file on the researchers' office computer (and backup hard drive) only. These records will be destroyed on the completion of the research. In this research, NVivo 10 software was used for coding the transcripts and organising the data. Using the NVivo gave additional protection to the data collected because data accessing requires the extra process of logging in to the software by the researcher user name and password.

In this research, the English language was not an issue because the interviews were carried out in Persian, the native language of the researcher and the participants.

4.6.3. The difficulties and sensitivities of obtaining information in Iran

Even though, my research topic was not sensitive, I had some difficulties in obtaining the information from the companies (e.g. accessing the companies' structure information) and accessing people (e.g. at one of the mosques, I did not get permission from the head of mosque to access the people). According to the current political situation of Iran, such as being under sanctions from the western countries, there was a negative reaction towards the researcher (being a student in UK) for obtaining information. It is believed even among the general public that any information collected could be used against the Iranian government.

During the time of my study there were some political issues between British and Iranian governments, which, as a consequence, their embassies in both countries were closed. I believe that this affected my study as the ethical panel committee were hesitant to approve my ethical application, by putting

difficult conditions in place for me to conduct the interviews in Iran. One of the conditions that was put in place was the 'pre-agreed emergency procedure' in the event that I did not return to my family at the expected time after interviews. The procedure was as follows: my brother was in charge in the case of an emergency. Prior to each interview, all information (interview place, person to be interviewed, and the time of starting and finishing the interview) was given to him. I had to contact him after finishing each interview. If I did not contact him within 2 hours of the time when the interview was due to finish, he had to seek further action by telephoning or visiting the location where the interview was due to take place. If my brother find no information at the venue of the interview, he would contact the emergency services. In the case of an emergency my brother was supposed to inform my husband, and he would communicate with my supervisors in the UK.

In addition, considering cultural issues relating to gender, I had to ensure that the interview process accorded with the social expectations in Iran, which require that a woman should not be alone with a man to whom she is not related. Accordingly, when I had an interview with a male participant, I had to take another companion (my sister) to the interviews. While the interviews were in process she was sitting at a distance or in the lobby, as she would not be involved in the interviews.

4.7. Data analysis methodology

As indicated earlier in this Chapter, this study adopted a qualitative approach and was concerned with deductive reasoning (section 4.3 p82). A deductive approach involves a structure or a pre-set framework to analyse data; in this

approach, the researchers could force their own structure to analyse the data (Spencer et al 2004, Williams et al 2004). Accordingly, this research, as a deductive approach, involved a predetermined framework of AWM to analyse data by focusing on the key AWM principles regarding the research objectives.

This section describes the methods used to summarise, organise and understand the data collected in this study. Most of the interviews were audio-recorded and transformed into the written transcription as soon as the researcher could do that. In the case of the interviewees who preferred not to be audio recorded (5 interviews with water professionals), notes of the interview were taken and a complete report was written as soon as the interview was finished. As the interviews were processed in Persian language, before managing data, all of the audio recorded interviews and notes were translated and transcribed to the English language for data analysis. The process was a complex procedure that firstly involved the listening to the recorded data and making transcriptions in Persian. Secondly, the transcriptions and the notes from Persian were translated into English. The translation process was not only a technical procedure of translating Persian words to English words; but involved an interpretive process to make sure to obtain the closest meaning to what the interviewees meant. Accordingly, the research interviews produced a great amount of words that needed to be handled by organising and arrangement.

4.7.1. Managing data using NVivo

The transcribed interviews were imported to the NVivo 10 software. NVivo is software that helps to organise and analyse qualitative data (Qualitative Software Research (QSR) International 2013). Managing the data included organising and coding the transcripts. The different folders were developed for each water companies (TWW and SEW), and also for each city's water consumers (Tehran and Varamin) in NVivo. As can be seen in Figure 4.8, the folders included the water professionals and consumers interviews folders. The interviews from each company were saved as the sub-folders under their own specific companies' name. Water consumers' interviews were saved as the sub-folders under the name of their cities. Each file is related to one interviewee with a special pseudonym which is only known to the researcher.

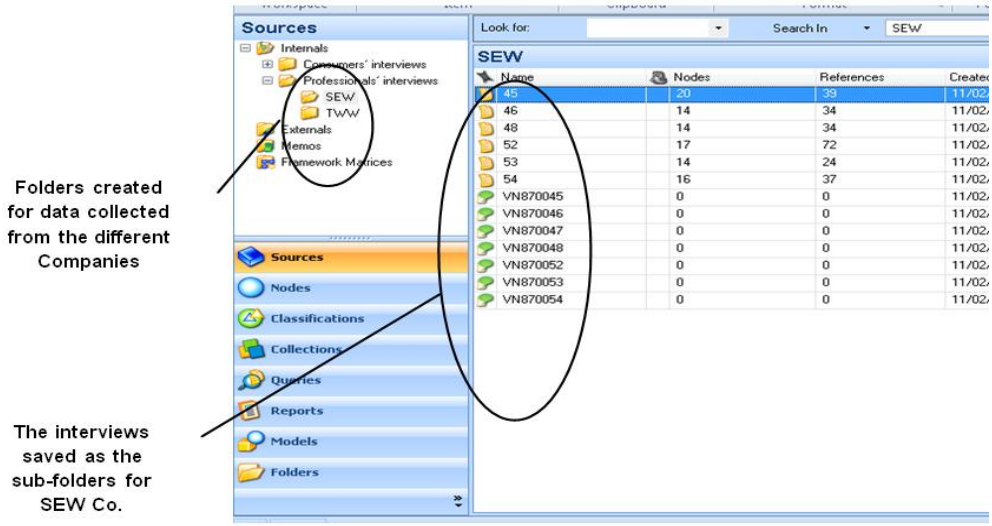

Figure 4.8 Managing data using NVivo

The analysis is using both free and tree node, however, using the tree structure helped to organise the data in a more efficient strategy. For example as can be seen in Figure 4.9, a parent node of Varamin challenges

could be clarified as the child nodes of financial, management of the company, population increase, subsidence phenomenon, water loss, water price, water quality and water supply.

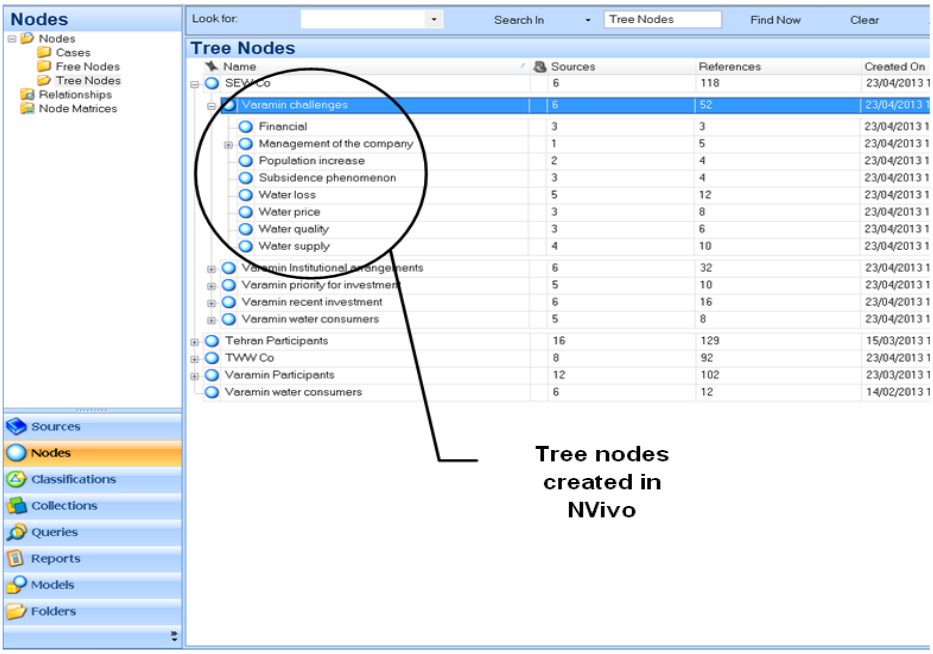

Figure 4.9 A parent node and the child nodes in NVivo

For analysing qualitative data, it is needed to find a sort of order within the data collected, and to understand how the data is related to the research objectives. Considering the research aim, objectives, and the research framework, preliminary categories had been established prior to analysis. As mentioned earlier in this Chapter, reviewing the literature provided a conceptual model of AWM (Figure 4.3 p90) to display and evaluate the key findings of this research. This conceptual model played a major role in coding and organising data during the process of research analysis. This model helped to organise findings and reduce a large amount of data down to key findings. Accordingly, the main categories or themes (nodes in NVivo) were

developed considering the questions asked for each characteristic of AWM (Tables 4.5 and 4.8). The nodes were selected and named for each company of TWW and SEW separately to enable us to compare them. It should be mentioned that no quality control checks were happening when the content analysis was performed, i.e. no one else was involved in the process.

4.7.2. Analysing online documents related to the water companies

As indicated by Bailey (1994), the use of documentary methods refers to the analysis of documents that include information regarding the case we want to study (Bailey 1994). This research used the case study water companies' online official archives and reports which were used in analysing data, mainly in Chapter 5. The online information from companies' websites was used. Common themes from different sources were used to draw conclusions. For example, to identify the process of the decision making in the companies, data were used from the water companies' interviewees as well as companies' online documents.

4.7.3. AWM characteristics evaluation

This section provides details of the data analysis methods that were used for each characteristic of the AWM framework. The evaluation used the characteristics of AWM for assessing the water management in Greater Tehran. The AWM conceptual model (Figure 4.3 p90) that was developed for this study helped to discover the adaptability capacity, and provided a foundation for the discussion of whether the AWM characteristics could be applied in the Greater Tehran water management. The conceptual model

allowed investigating AWM three main principles of polycentric governance, institutional flexibility and public participation. The analysis highlighted how the companies are running by centralised or polycentric governance, how their internal management are, and what their relationships are with their water consumers.

An important element of the data analysis was comparing and linking to draw conclusions about the AWM characteristics. As the AWM is the study's framework; the recognition of the possible link between the AWM characteristics is an important consideration in the analysis. For example, the pattern of institutional flexibility regarding water use may be linked to the social knowledge and information people are receiving from policy makers. Or analysis of the institutional flexibility may be linked to internal management of the institution highlighting the level of interaction between individuals working in the institution. Comparison of the different perspectives on these topics of the professionals on the one hand, and the public on the other hand is therefore important. Consequently, data about the professionals are analysed alongside the public data. Comparison between the water consumers and the professionals could draw attention to the water management interfaces in practice, and also could highlight the possible gaps between different parties involved in the water management. The results in Chapters 5, 6 and 7 respectively discussed the findings related to polycentric governance, institutional flexibility, and public participation. All interviewees' quotations in these Chapters are indicated in italic fonts. The following sub-sections provide details of how the AWM characteristics were identified and extracted from interview transcripts.

4.7.3.1. Polycentric characteristic

Chapter 5 discusses the findings related to the polycentric governance characteristic. Two categories were investigated, firstly, companies' decision making process, and secondly, their cooperation with external organisations through analysing the primary data collected related to the polycentric governance characteristic. These categories highlight the companies' governance adaptability by examining the interviewees' responses to the open questions indicated in Table 4.5 p101. Investigating these categories indicates the current governance status of the water companies (centralised or polycentric). Table 4.9 shows the polycentric categories investigated and the examples of the interviewees' responses.

Categories of polycentric governance	Example of responses
Companies' decision making process	*"The decision making was with the company's managers and with permission of the Ministry of Energy Interviewee" (Interviewee NP)*
	"I suggested the Nano method that I had a lot of information about. They did not allow me, if I had a higher position maybe my proposal would have been considered for implementation" (Interviewee AS)
	"Company depends on a person. A manager comes with different view and as the result it is possible the present working projects end up unfinished" (Interviewee FA)
Companies' interactions with other organisations	*"Our company cooperates with the standards office; we have formed technical committees for this purpose" (Interviewee MI)*
	"In the wastewater issue we have the most difficulty with municipality, even for digging the alleys, the license should be obtained from the municipality" (Interviewee NA)
	"We do not have to answer to the municipality; the only point for our cooperation is our need to the legal ground" (Interviewee MI)

Table 4.9 Categories of polycentric governance

4.7.3.2. Institutional flexibility

Chapter 6 discusses the findings regarding institutional flexibility. The participants answered the open questions related to the institutional flexibility characteristic shown in Table 4.5 p101. Two main categories are investigated regarding the institutional flexibility characteristic: the companies' response to the water challenges (technical or institutional), and the interactions between the different levels (internal management) in each company.

Category of companies' response to their water challenges: for drawing the conclusion on institutional flexibility, the companies' responses to their current water challenges were investigated. As can be seen in Table 4.10, six technical challenges were derived from interviewees' responses as they answered the open questions of: the main threat to Tehran's water system, the companies' recent investments and the priority areas for investment. The vast majority of investments of the water companies were used for addressing technical challenges. Technical challenges were involved with water loss, water supply, water quality, subsidence phenomenon, Wastewater system and new technologies. Three institutional challenges also were derived from the interviewees' responses to the questions that are mentioned above. These were the financial problems, water price, and population increase (Table 4.10).

Category of companies' internal management: for drawing the conclusion on the institutional flexibility, the findings regarding the level of interactions between different groups and individuals within the companies were also investigated. As can be seen in Table 4.10, the interviewees' responses regarding the internal management were investigated by examining the level

of interactions between different groups and individuals within the companies. Table 4.10 shows these categories and the examples of the interviewees' responses.

<table>
<tr><td>Categories of institutional flexibility</td><td colspan="2">Example of responses</td></tr>
<tr><td rowspan="7">Companies' response to their water challenges (technical or institutional)</td><td rowspan="5">Technical challenges</td><td>Water loss
"Our existing water network in Varamin has been extremely deteriorated, the water leakage causes a lot of damage, we have homes being damaged" (Interviewee MR)</td></tr>
<tr><td>Water supply
"The most important challenge of the urban water is supplying the water"
(Interviewee KA)</td></tr>
<tr><td>Water quality
"We have done the greatest job since two and half years ago, for the first time in the history of Tehran, we made the same water quality in the north and the south of the city" (Interviewee MO)</td></tr>
<tr><td>Subsidence phenomenon
"Taking water from the plain of the Varamin for agriculture and for drinking with wells is causing subsidence phenomenon, this is one of the concerns of the city's authorities." (Interviewee SO)</td></tr>
<tr><td>Wastewater system
"If we could transfer the wastewater from Tehran, or if we put our waste water system into the operation in our city, it would be a very big step in helping our water resources" (Interviewee MR)</td></tr>
<tr><td rowspan="2"></td><td>New technologies
"We want to take the establishments, the equipment, and the water distribution network towards being an automated system" (Interviewee KA)</td></tr>
<tr><td rowspan="3">Institutional challenges</td><td>Financial problems
"As an expert one of my jobs is to search for the best solution; more than 90% of our suggestions are facing the closed doors such as not having the budget, which is discouraging" (Interviewee FA)</td></tr>
<tr><td>Water price
"The water tariffs are given to us by Government, and these tariffs are not balanced with our needs, TWW is sustaining a loss" (Interviewee MI)</td></tr>
<tr><td>Population increase
"Varamin had a great population increase in recent years and our water resources are not enough for this population" (Interviewee SO)</td></tr>
<tr><td>Companies' internal management (interactions between the different levels)</td><td colspan="2">"Maybe the biggest concern in our company is the relationships selection, the authorities' selections are based on the relationships" (Interviewee AS)

"The most challenging issue is the weakness of the management; the management is resistant to change" (Interviewee FA)</td></tr>
</table>

Table 4.10 Categories of institutional flexibility

4.7.3.3. Public participation

For investigating the public participation, two categories of water companies and water consumers' perspectives were examined through the interviews transcripts. Data related to the public participation from both groups of water professionals and water consumers were analysed. As can be seen in Table 4.11, two categories of water companies and water consumers' perspectives are investigated. This was done to highlight the adaptability of the Greater Tehran water management regarding the public participation characteristic.

Categories of public participation		Example of responses
Water companies' perspective	Public as water receivers	*"We provided the 24 hours water for everybody in all areas of the city, our intention is that the water to be there with the acceptable quantitative and qualitative standards" (Interviewee KA)*
	Public as a part of water management	*"If we explain things to people and inform them, a lot of our problems could be solved. A part of our problems is lack of public information" (Interviewee SO)*
Water consumers' perspective	Received information	*"It was a children's program regarding water saving, for example closing the tap during tooth brushing. It had an effect on my kids" (Interviewee2).*
	Water price	*Why keep the water tap running while you are doing something else, this is not economic and increases household costs" (Interviewee 67)*
	Personal values and practices	*"I try to use washing machine two times per week by separating the different colour clothes" (Interviewee 28).*
	Degree of trust towards water authorities	*"We know that the water is polluted, if the company was caring for people should have told people that the water is polluted" (Interviewee 49)*
	Involvement in water management	*"My suggestion to the water company is to update their piping, using the new materials, their worker should know their job and ensure they did not come to gain experience" (Interviewee 55)*

Table 4.11 Categories of public participation

A significant element of the data related to the water companies was to help draw conclusions about the public role in the water management. Considering water consumers, data was analysed to examine their relationships with the water companies, and how they see their role in their cities' water management (water receivers or a part of water management). Analysing water consumers highlighted five main factors that are: received information, water price, personal values and practices, degree of trust towards water authorities, and public interest in the involvement in water management.

4.8. Chapter summary

This Chapter has provided a detailed description of the methodology that was used to collect and analyse data for better understanding of the AWM in Greater Tehran water companies, and the water consumers. As indicated in the Chapter, the research involved three stages. The first stage was the literature review that examined the current water management approaches in the last century, introducing the AWM as a sustainable alternative approach. This review collected the data that helped to address the research objectives and also helped to build a framework for evaluating the AWM characteristics through Greater Tehran water companies and water consumers. Stage 2 was a case study involving two cities of Tehran and Varamin water companies and their water consumers. The data collection methods included semi-structured interviews and document analysis. Stage 3 involved the analysis and evaluation of the AWM characteristics. Data analysis methods included using NVivo 10 software, summary notes, content analysis of the interviews,

identifying the common themes from the data regarding the research framework of AWM. The framework provided a foundation for the discussion of whether the AWM characteristics could be applied in Greater Tehran. The framework helped to discover how the companies are running by centralised or polycentric governance, how flexible their strategies are, and what they relationships are with their water consumers.

Chapter 5

Polycentric water governance

5.1. Introduction

This Chapter aims to explore the water management of Greater Tehran regarding the polycentric governance characteristic. For this purpose two main issues were investigated in the water companies. The issues were the companies' decision making process and the companies' interaction with external organisations (Figure 5.1).

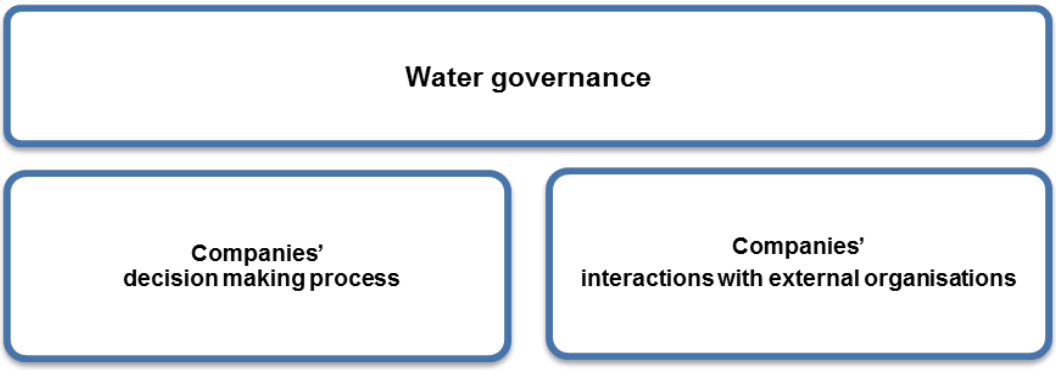

Figure 5.1 Companies' water governance

The Chapter draws mainly on data from professionals' interviews of TWW and SEW companies. For better understanding of the data analysis, the Chapter starts with a description of Tehran Province Water and Wastewater Company (TPWW Co) structure, and then examines the current status of the companies (private or part of government), observation of the companies' offices, and the interviewee demographics. The main issues pertaining to water governance are then discussed. The Chapter ends with a conclusion that places the achievements of the Chapter in the context of the thesis.

5.2. Tehran Province Water and Wastewater Company

TPWW Company was established in the year of 1992 due to the consideration of the parliamentary law. TPWW Co and its sub-companies are in charge of supplying and distributing urban water, water distribution, as well as establishment of other installations related to the collection, disposal and treatment of wastewater in the cities of Tehran Province. TPWW Co functions as headquarter, policymaking body, and umbrella structure for the executive companies in Tehran Province having 5150 permanent and 2600 temporary staff (TPWW Co 2011) (Figure 5.2).

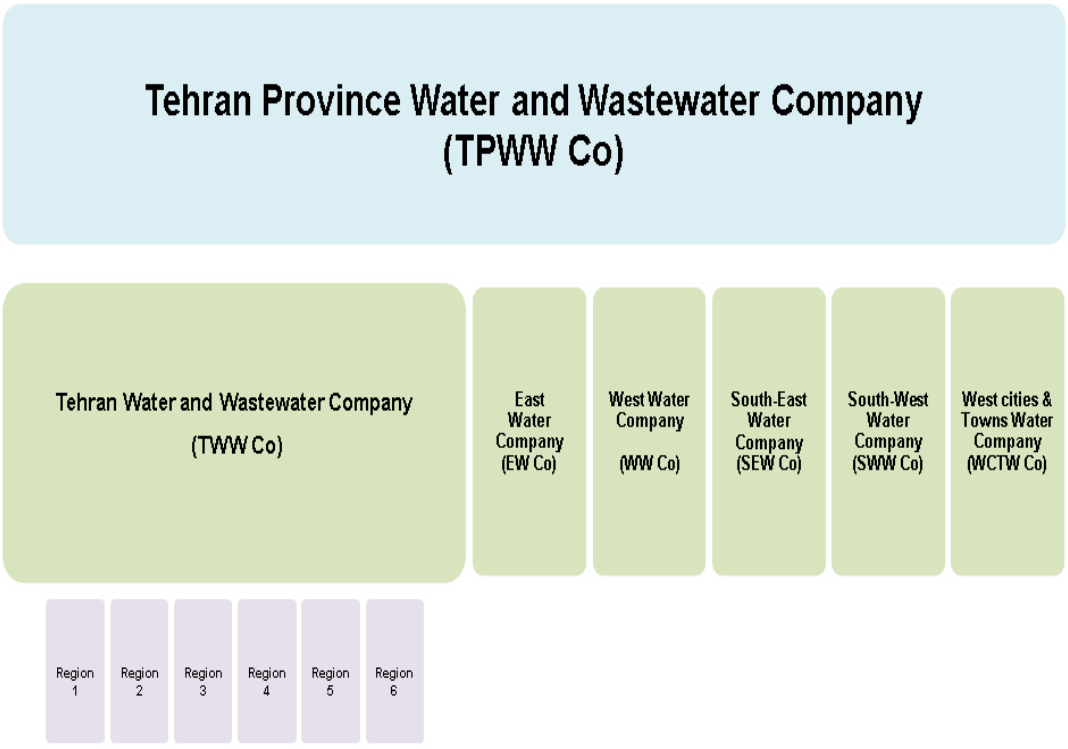

Figure 5.2 Tehran province Water and Wastewater Company (TPWW Co 2011)

Figure 5.3 presents the locations and the areas of Tehran province that are covered by different water companies of TPWW Co.

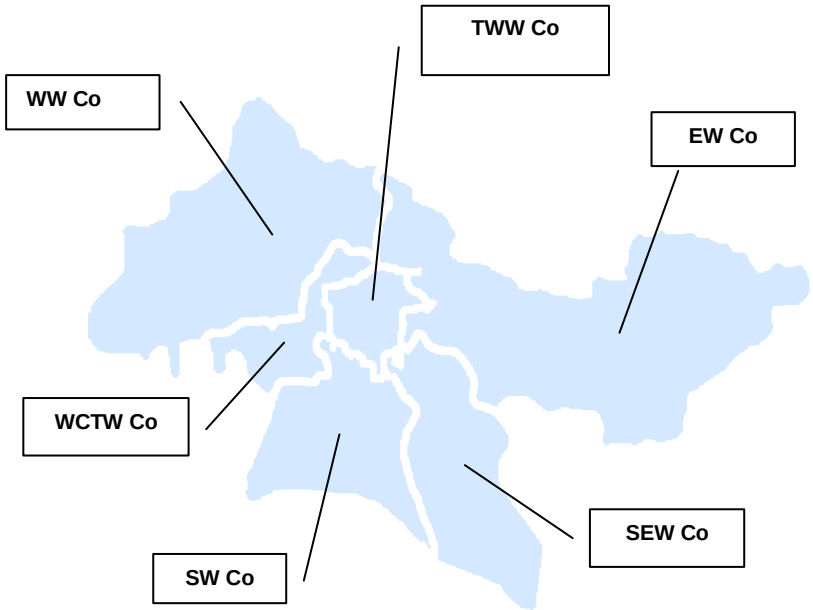

Figure 5.3 Locations of Tehran province areas covered by TPWW Co.

5.3. Types of water companies

This section tries to give an understanding of the types of TWW and SEW companies. The findings from the companies' websites stated that TWW and SEW are registered as private companies, with boards of directors and the chief executive officers. However, when the interviewees were asked about the type of their companies (private or a part of government), there was confusion over the state of the companies among them. One interviewee from TWW Co indicated that:

> *"In fact, we are a half private company that is working under government supervision, all costs and investments are supervised by Ministry of Energy" (Interviewee MG, TWW Co).*

Another interviewee from SEW Company said:

> *"It is true that our company by name, is a private company, but we are using the Government facilities and are being observed by the inspection office of the country, we are somehow a subdivision of Ministry of Energy" (Interviewee SH, SEW Co).*

As discussed in Chapter 3 p62, since 1980, Iran water management promoted to reform in water institutional and the policies. From 1990 onwards, the water related activities in Tehran province were carried out by the TPWW Co. Considering the institutional reform indicates that there is recognition among the water decision makers by involving the private sector in the water management. The idea of establishing the TPWW Co was to allow the private sectors to be involved in the water management. In this way, the private sectors should be responsible for production and services while the Government acts as a monitoring body. This study was carried out in the TWW and the SEW companies that are part of TPWW Co for more than 20 years after introducing the reform. The findings highlighted that the implementation of the privatisation did not go successfully. The findings show that, despite the companies being registered as private, they depend on the governmental regulations and budget. The companies actually are under governmental supervision and they cannot make decisions without the Ministry of Energy's approval. They have to follow the governmental policies and act as a part of the government bodies. One of the senior managers indicated that:

> *"The privatising had been followed in the past and our company wanted to become completely private, but when the*

water price should be determined by the Economic Committee in the Government, this issue (privatisation) could not be followed. In addition from the constitutional law, water supply is the Government responsibility, then the privatising of the company is out of reach" (Interviewee AR, TWW Co).

5.4. Observation of the company offices

TWW Company is located in an urban area in the centre of the city of Tehran. During my fieldwork I spent most of my time in the city of Tehran, which allowed me to access the company easily. The company is covering a large area, and has different gates in different streets, with the checking entrance securities. The company had a high security for the people to go inside the company. Each time, for going inside the company, I had to give my ID card to the security guards, and they had noted my name, and my entrance time to the company in their book. Each time after doing my interview, for going out of the company, I had to give the security guard a signed paper by the office I had visited, indicating where I was in the company to get my ID card back. However, inside of the company I had the freedom to go to different places and talk to the people. After my first meeting with the company's head, I got the permission to go to the different offices and talk to the professionals freely. In this way I had the opportunity to speak to the water professionals explaining my research aim and how they could help me in my research, and asking their permission for the interview. I arranged the interviews with the professionals that were interested.

SEW Company is located in an urban area in the city of Varamin, and comparing with the TWW, is smaller in size. I was introduced to the SEW Company by one of the senior managers of the TWW Company. This introduction made my job easy in the SEW Company, because they knew I had the same interview procedure in the TWW Company. Because of the distance and travelling issues, I had to arrange the interviews through phone calling. Entering the company was much easier than TWW Company. After my first visit to the company, I became a familiar face to the security guards, and afterwards I had no problem for going inside the company. In addition, I had an interview in one of SEW buildings in the populated central city which was open to the public. The buildings had two floors. The First floor was an open area with several kiosks where people could go and say their requests. The second floor was the company's employee offices that were also open to the public. There was no security in the entrance and people were free to go inside to the different offices and have their say regarding their water problems. My interview with one the water professionals in his office in the second floor was disrupted several times by the people.

The observations of the companies showed the friendlier environment of SEW Company in the smaller city of Varamin, compared to the TWW Company located in the big city of Tehran.

5.5. Interviewee demographics

This section gives a description on the research interviewees' demographics of organisational positions, and the length of employment in the companies. The research involved 8 and 6 interviews with the professionals of the TWW

and SEW Companies respectively. Interviewees had different organisational positions, and the lengths of their service in the companies. Table 5.1 provides the information on the interviewees' background regarding their years of working in the companies.

Years in the company	TWW Co	SEW Co
	No. of interviewees	No. of interviewees
< 10	2	2
< 15	2	3
< 20	2	1
< 25	1	0
>25	1	0

Table 5.1 Interviewees' employment Length

Table 5.1 shows that the interviewees have a range in the length of employment between under 10, to o''ver 25 years of working within the companies. This indicates a varied range of the experience in the water sector according to the interviewees.

5.6. Polycentric governance

As indicated in Chapter 2 p26, adaptive management supports the polycentric governance, which means decisions are achieved by various authorities and organisations. The governance of AWM is shaped around the social networks of knowledge and information with the water related organisations. Von Korff et al (2012) highlighted that the concept of adaptive management is closely linked to the concept of social learning, emphasising collaboration between various organisations involved in water sectors. This section discusses the current water governance of the Greater Tehran

considering two issues, the water companies' decision making process, and the companies' interaction with external organisations. The section reflects on the companies' willingness towards polycentric governance in Greater Tehran water management.

5.6.1. Companies' decision making process

This section discusses the process of decision making in companies. This is done by examining the interviewees' responses to the interview questions related to the process of their company's decision making, and how their company was running considering their experiences. Most of the interviewees indicated that their company is following the Government policies. The Government provides some part of the companies' budgets, and gives them guidelines about how they could spend that. Accordingly, the companies follow the Governmental strategies depending on their companies' challenges and priorities. The results show that the top managers of the companies are not pleased with the Governmental interference in their companies. One of the senior managers indicated the Government challenges their companies by weakening their control and power:

> *"The Governmental interference is challenging the decision making process. The main challenge is the lack of control, and comprehensive management for making the decisions in our company" (Interviewee AR, TWW Co).*

Having governmental supervision makes top managers have less power in their companies. The companies' senior managers' lack of power and being

dependent on the Government make them weak to take the decisions as private companies. One of the interviewees indicated that:

> *"You should always have this process in your mind, the process of the selections, the letter comes from the Ministry to the Province Water and Wastewater Company and from there to here" (Interviewee AS, SEW Co).*

However, the companies have flexibility to make decisions considering their regional and local circumstances. One interviewee stated that:

> *"A lot of activities are suggested by our department, for example we proposed to the company's Chief Executive that some of our jobs could be done by private contractors, such as guarding our wells" (Interviewee MR, SEW Co).*

The findings highlighted that in TWW and SEW companies, the final decisions are up to the senior managers, and they play an important role in the companies' decision making. Without the senior managers' support and agreement, the investments and projects will not be approved. One of TWW Company interviewee said:

> *"The decision making was with the company's managers and with permission of the Ministry of Energy" (Interviewee NP, TWW Co).*

Another interviewee from SEW Company stated:

"It was needed for the director of the company to make the decision, and then his deputies, and afterwards the subset of managers" (Interviewee RA, SEW Co).

The above findings show that the institutional arrangement of TWW and SEW are following the governmental policies, and the decision making is mainly a process between the upper managers of the companies.

5.6.2. Companies' interactions with external organisations

The interviewees were asked if they have collaboration with other organisations regarding their companies' activities and decision making process, and the intention was to understand the level of companies' cooperation with the external organisations. The findings emphasised that the TWW and SEW companies have cooperation with the external organisations. Most of the interviewees stated that for doing their jobs they have to cooperate with other organisations. One of the interviewees indicated:

"From two years ago, we focused on the equipment standardisation. Our company cooperate with the standards office; we have formed technical committees for this purpose" (Interviewee MI, TWW Co).

Another interviewee replied:

"When we do the network correction, it is necessary that the municipality, servicing offices, and governor have been

informed. If we want to put a well in operation, we should cooperate with different organisations" (Interviewee SH, SEW Co).

The findings showed that it is necessary for the water companies to have the connection and cooperation with certain organisations such as; gas, electricity and mostly the municipality in their cities. However, some interviewees see the cooperation with the municipality as the obstacle for their job; they feel the cooperation process as an unnecessary procedure of getting permissions for doing their jobs, as one interviewee described:

"*Permission means give them money" (Interviewee AS, SEW Co).*

Some stated that the other organisations are not cooperating with them. The interviewee remarked:

"The main problem is that we have zero cooperation with the gas company, when they work, it is possible to cut through the water pipes (Interviewee MI, TWW Co).

The findings show that the interactions with external organisations are mainly based on the official procedure rather than true interactions. The companies are in cooperation with other companies but as bureaucratic procedures.

"We do not have to answer to the municipality; the only point for our cooperation is our need to the legal ground" (Interviewee MI, TWW Co).

As indicated by the interviewees, sometimes these bureaucratic procedures act as the barriers regarding the activities of the companies. One of the interviewees stated:

> *"In the wastewater issue we have the most difficulty with municipality, even for digging the alleys, the license should be obtained from the municipality" (Interviewee NA, SEW Co).*

However, some findings show a recent collaboration between companies, and the environment office and the standards office. As indicated by the interviewees, this cooperation is based on the teamwork and a network of information. This cooperation indicates an interest in the companies' management towards more sharing of social information with external organisations. However, some of the interviewees think these kinds of cooperation makes their jobs progress slowly. Regarding the cooperation with the environmental office, one of the SEW Company's interviewee said:

> *"In wastewater we are doing a series of studies on our network, transferring lines and filtering facilities and we also recently (2010), doing a series of studies for environmental assessment. Usually we hire the consultant, the consultant offers its proposal to the TPWW Co, the approved proposal would be sent to the province environmental main office and they assess the proposal in their technical offices.*
>
> *Interviewer: what is your opinion on the environmental assessing?*

In my view, it is a good process, but they should look to the proposals comprehensively, means they look positively to the job, give the permissions that are needed more quickly. We had sent the Pakdasht environmental assessing for three months now, we are following, but still there is no news

Interviewer: you think the process is slow?

Yes, imagine someone wants to establish a livestock farm to raise domesticated animals, these barriers are delaying the job" (Interviewee AS, SEW Co).

Having the decision making process of the companies and their relationship with external organisations, highlighted the key issues regarding the polycentric characteristic. The findings from the case study stressed that the companies despite being registered as private are under governmental supervision. Their budgets mainly come from the Government, and the companies' Chiefs Executives are appointed by the Ministry of Energy. The decision making in the companies needs to follow the guidance set out by the Ministry of Energy, but there is some flexibility for them to interpret this in ways appropriate for their local circumstances. Regarding one of the recent investments, one of the TWW Company's senior managers said:

"The decision making was with the company's managers and with permission of the Ministry of Energy.

Interviewer: who took the decision?

The board of directors of the company took the decision" (Interviewee NP, TWW Co).

The characteristic of polycentric governance means decisions are carried out by cooperation between various stakeholders (see Chapter 2 p26). In fact, until 1990 the water governance in Iran was carried out mainly by the municipalities, and the regional government. As mentioned by Mahmoudian (2004), that kind of relationship was not working, and had difficulties regarding the clean water and discharge of wastewater. The unsuccessful experience of having several authorities involved in water decision making in the city of Tehran led the water management towards a more centralised governance. It seems this failure is still affecting the view of the water managers in Tehran, and they believe that the water management should be in hand of one organisation and centralised. One of the senior managers of TWW Company mentioned some small private companies around the city of Tehran that are providing water in some areas. The TWW Company is taking legal action in order to take over those companies. There is a doubt about sanitation of the water provided by those companies, because they are not under regular Health Ministry investigation. The health of water supplied by the small private companies is not guaranteed by the Ministry of Health. In fact they are not under supervision of the Government. The interviewee highlighted:

"TWW Company and Ministry of Health have complained to the judiciary about the private water companies, and we are looking forward to joining them to TWW Company as soon as

possible" (Interviewee MO, TWW Co).

One of the interviewees in the SEW Company also highlighted areas in the city of Varamin that are not covered by the company:

"In the past, some of the people gathered and dug a well and piped the water, in fact they are private. Gradually our company took some of them under its cover because they are inside the city's boundary and their water should be hygienic. However, some of them are not under our supervision; we are not sure the water they are providing is hygienic.

Interviewer: do people in those areas know that their water is not from your company

Yes, because they do not receive any water bill, they pay monthly (Interviewee NA, SEW Co).

Overall, the Chapter findings indicated that in terms of the polycentric governance, neither of the companies could be indicated as adaptive. Polycentric governance characteristic is shaped around the social networks and interactions with external organisations, and various authorities are involved in process of decision making. For understanding the water governance of Greater Tehran, two issues of companies' decision making process and the companies' interactions with external organisations were investigated in the companies.

In the level of decision making, the findings highlighted that the companies, despite being private in the name, act as a part of the Government. The

companies are depended on the Governmental budgets, and the companies' Chiefs of Executives are appointed by Ministry of Energy. Accordingly, they follow the guidance set out by Government, and they cannot make decisions without permission from Ministry of Energy. The companies have only freedom to interpret governmental regulations depending on the companies' challenges and priorities. Moreover, the companies have established centralised governance. In the companies without the senior managers' support and agreement, the investments and projects will not be approved. The top managers in the companies believe that the water management should be centralised, and one authority should be responsible for dealing with all regions. Thus, TPWW Company is seeking to take action to take over the remaining small companies, in order to be the one water company for Greater Tehran.

In the level of interaction with external organisations, companies have mainly bureaucratic cooperation, and official procedure with external organisations. For example, companies have routine cooperation with municipality, and the organisations of gas and electricity. However, there are signs of starting some true interactions with the external organisations. The findings show some interactive cooperation with external organisations such as environment office. This indicates the companies' interest towards being more adaptive (Figure 5.4).

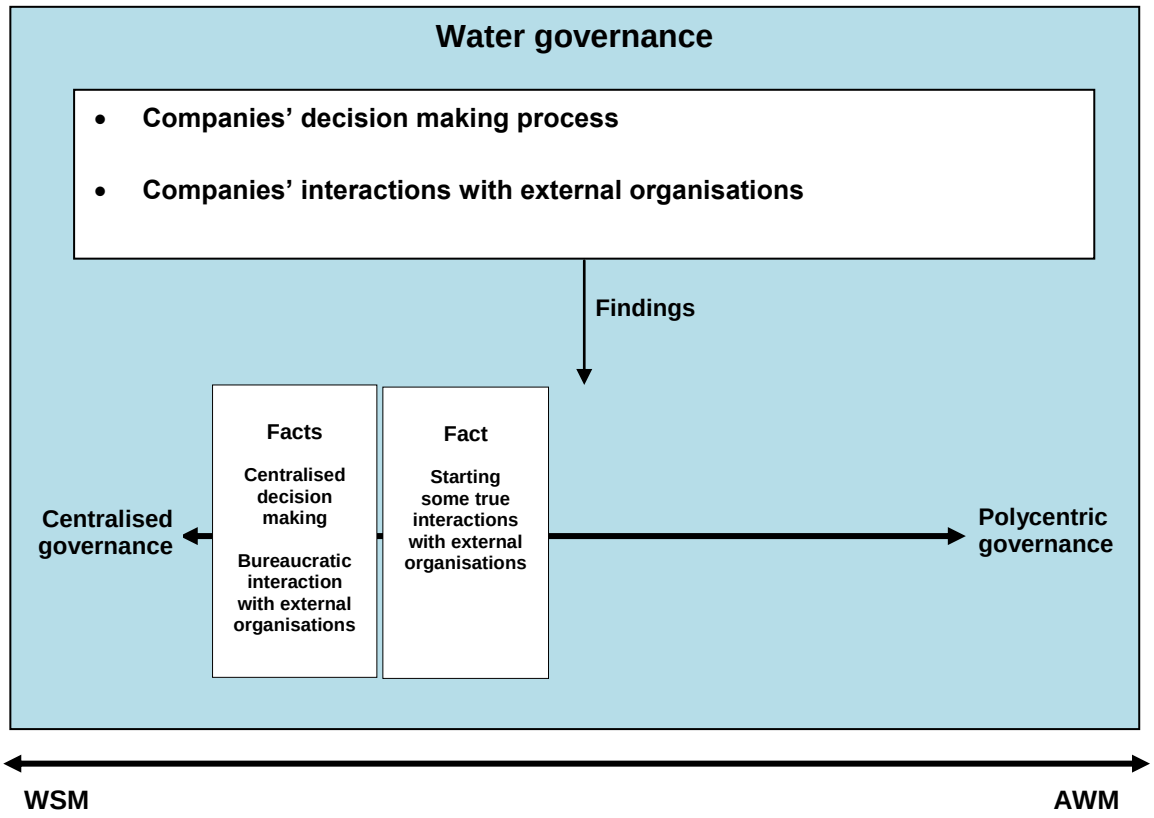

Figure 5.4 TWW and SEW water governance adaptability

5.7. Chapter conclusion

The Chapter investigated two water companies in Greater Tehran to highlight the possible adaptability in the companies. The findings showed that the TWW and SEW companies act as a governmental sub-section, and are dependent on the governmental financial help. Companies follow the governmental strategies depending on their challenges and priorities. The interactions with external organisations are more related to the official procedure rather than true interaction. Accordingly, the current situations of the companies are not in favour of Adaptability. Having established the extent to which the companies demonstrate polycentric governance, the following chapter will turn to the second AWM characteristic, institutional flexibility.

Chapter 6

Institutional flexibility

6.1. Introduction

This Chapter examines the characteristic of institutional flexibility in the water companies of Greater Tehran. This characteristic involves how the companies adjust their strategies and policies over time and also how the different individuals and groups interact in the companies. Accordingly, two main issues of the companies' responses to their water challenges (technical, institutional), and the level of interaction within the companies were investigated in this Chapter (Figure 6.1).

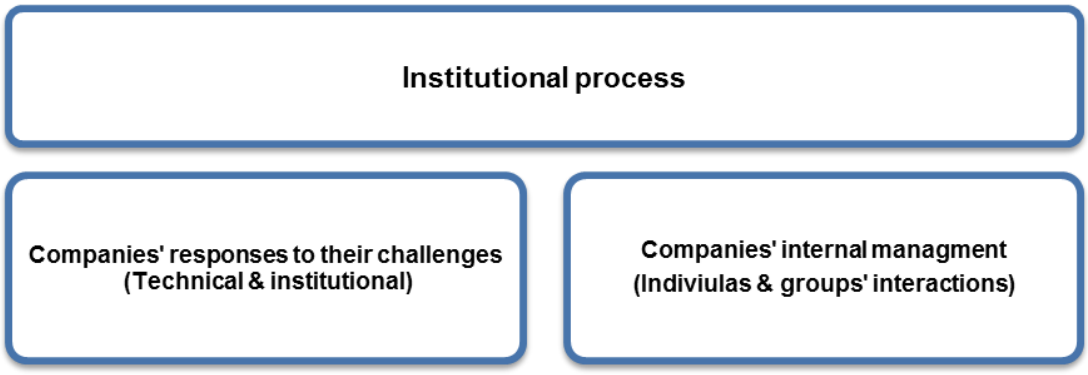

Figure 6.1 Companies' institutional process

6.2. Companies' responses to the current challenges

As indicated in Chapter 3 p47, water management in Greater Tehran suffers from the common features of the water supply systems similar to many developing countries, such as, ageing infrastructure, high water losses in the distribution system, and also poor management and institutional framework.

The case study highlighted the two main categories of technical and institutional challenges. The findings indicated that companies mostly show technical flexibility by focusing on addressing the technical challenges. The recent investments in the TWW and SEW companies are related mostly to the technical challenges of water loss, water supply, water quality, wastewater system, and the new technologies. The institutional challenges are not the first priority for the companies, and the companies institutional challenges are failing to be addressed. In other words, the companies are showing the flexibility mostly on the technical basis, or engineering side of the water management which is the characteristic of WSM. This section reflects on research objective 1 (water challenges), by highlighting the companies' water challenges, and discussing the policies and strategies of the TWW and SEW companies, and how the challenges are being addressed in terms of policies and implementation. The section contains analysis of three interview questions concerning water challenges, recent investment, and the water professionals' opinions regarding the companies' priority investments.

Companies' water challenges

The interview asked: what is the main risk or threat that Tehran and Varamin water managements are facing. The aim of this question was to examine the views of the interviewees on the main water challenges, and what their companies were doing to address these challenges. The interviewees from two companies of TWW and SEW referred to 8 major challenges of water loss, water supply, financial problems, water quality, companies' internal

managerial problem, water price, population increase, and subsidence phenomenon. The internal management of the companies as a challenging issue was indicated mostly by the TWW Company employees. The water loss and water price were more challenging issues in the SEW Company, compared to the TWW Company. Also the subsidence phenomenon was only indicated by the SEW professionals as one of the most challenging matters for their company.

Companies' recent investments

The question was asked about companies' recent investments. According to interviewees' responses, there were 5 main areas of investment in TWW and SEW companies. Companies had four main investments on water loss control, finance management, wastewater system, and the new technologies. In addition, TWW Company was conducting a big investment in the water supply network for the city of Tehran.

Companies' investment priorities

This question asked: If you had extra financial resources to invest in Tehran's and Varamin's water management, what would you see as the priority areas for investment? The aim of this question was to examine the views of the interviewees on the priority of investments in their companies. The TWW and SEW professionals had common point of views on the investment priorities of water loss control and wastewater system. The TWW professionals believed that there should be more investment in the water consumption management and water quality. On the other hand, the SEW professionals indicated that

there is a necessity to invest in some kind of information bank for gathering the city's water related issues. Figure 6.2 summarises the TWW and SEW companies' challenges, recent investments, and the priority of investments.

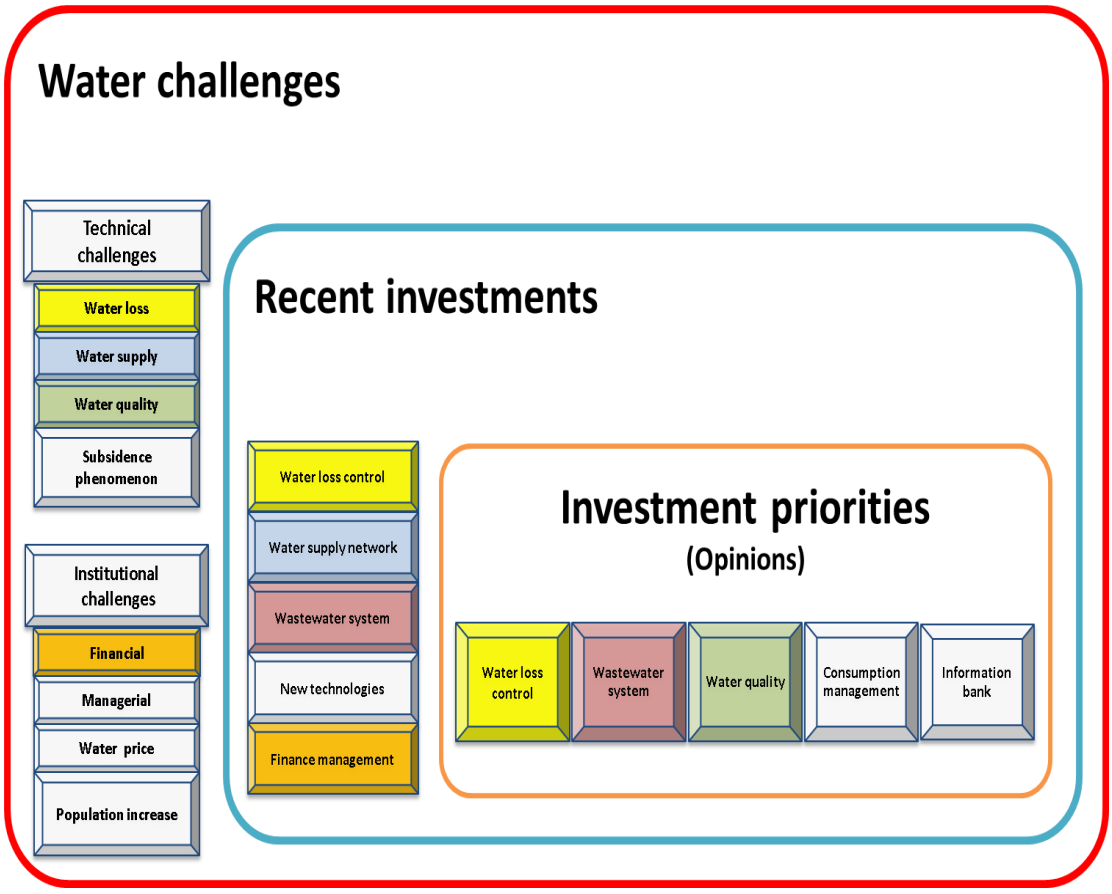

Figure 6.2 Companies' challenges, investments and investments priorities

Figure 6.2 shows the companies' challenges, and those challenges that are currently being invested. In addition investment priorities from the professionals' point of views are shown. The companies' challenges could be divided into two groups of technical and institutional challenges. The technical challenges include water loss, water supply, water quality, and the subsidence phenomenon challenge that is specific to the city of Varamin. The

institutional challenges include financial problems, companies' managerial problem, water price, and population increase. The following sub-sections involve analysis and discussion of the outcomes of the technical and institutional challenges and investments, by presenting the quotations of some of the interviewees.

6.2.1. Technical challenges

This section discusses the technical challenges of water loss, water supply, water quality, and subsidence phenomenon and how they are being addressed in TWW and SEW companies. In addition, the interest of the companies towards the new technologies is highlighted.

Water loss

The findings highlighted water loss as the most significant challenging issue for companies of TWW and SEW. This challenge is addressed through the recent investments in both companies. One of the TWW professionals said:

> *"Water consumption in Tehran on average is 270-300 litres per person per day, however this water is used for maintaining green spaces and firefighting, also around 22%-25% of Tehran's water is lost from the network structure failure, such as pipe-line deterioration, pipe line breakage, inaccuracy of water meters, and illegal piping" (Interviewee NP, TWW Co).*

The water loss control as a priority for investment was indicated by the interviewees. One of the senior managers indicated the examination of the

water supply as a priority investment:

> *"My first priority would be technical checking of the water network system, and studying the water supplying network exhaustively, because we have limited water resources" (Interviewee AR, TWW Co).*

One of the TWW Company experts mentioned the recent investment in the water loss control:

> *"There has been a lot of debate on the water without revenue or water loss, we could reduce some of the water loss, some of our jobs in the city of Tehran are reducing the water network incidents and pressure management" (Interviewee MI2, TWW Co).*

However, the findings indicate that the TWW Company was experiencing some technical difficulties in water loss. One interviewee commented:

> *"We did not have a good experience of using plastic pipes; we bought the pipes from different companies that were different in the materials. Therefore those pipes had caused a lot of damage to our water network" (Interviewee MI, TWW Co).*

Water loss in Varamin is also a big challenge for the SEW Company. As indicated by one of the SEW Company's professionals, the city is losing water through deteriorating pipes:

> *"Our existing water network in Varamin is extremely deteriorated, for this reason we have water leakage, this water leakage causes a lot of damage, we have homes being damaged" (Interviewee MR, SEW Co).*

Water loss control is the most important priority for investment in Varamin as mentioned by the most of the interviewees. One interviewee indicated:

> *"If we could correct the distribution network, we could reduce the water loss, and have helped our resources, then the best way is to correct our distribution network" (Interviewee MR, SEW Co).*

The interviewees mentioned that the water company invested in water loss control by the restoration of the old piping, and reducing the water pressure of the water network. One interviewee commented:

> *"We worked on restoration and renovation of the city's main transition pipes; we lowered the pressure which decreased the rate of the pipe breakage and accidents" (Interviewee MR, SEW Co).*

The SEW Company recently invested in a study of DMA (District Metering Areas), to find out more about how water loss occurs in Varamin. One of the managers said:

> *"We made an isolated area with the water meters which determine the water input and consumption, a contractor did*

> *that for us, and we are pleased with it. We found out that the water loss is costing the company a large amount of the money, because people's water meters are not accurate, or it is possible they have no water meter at all, for example they could be use an illegal split or the water meter that has been manipulated" (Interviewee SO, SEW Co).*

The water loss problem seems more complicated in Varamin compared to Tehran. The findings in Varamin indicated that the water loss involves social and institutional factors as well as technical issues. Due to the previous management of the SEW Company, there is no available information of the city's water supply network. They do not know what has been done in the past as there is no recorded data. One of the company's experts said:

> *"You may be surprised if I told you when I started to work here there was no map on the city's water network. Nobody felt that the map was necessary. It was the first day of my job here, I went and asked my boss for a copy of the city's network map, he said we do not have any" (Interviewee AS, SEW Co).*

Accordingly, the detection of the water leakage and broken pipes is a difficult job in the city of Varamin. In the case of incidents, there is no information on the age of piping and the map of the water network. The knowledge about the city's water piping is mostly among the local plumbers, and it is up to them to provide the right information to the company. There is some kind of mistrust towards local plumbers' information in the company. The company's

employees believe that local plumbers are not giving the right information to them because they think if they tell the right information they won't be needed anymore:

> *"When the head of company changed, he hired a consultant and they started to make the map of the water network, they called the local workers and asked them, for example, what did you do 10 years ago. Making the map was then based on speculations and often they did not give the right information, why? They are workers and they were thinking if they tell the right information they won't be needed anymore" (Interviewee AS, SEW Co).*

Findings highlighted that the illegal piping is commonly used in the city of Varamin. One of the SEW Company's professionals highlighted the illegal piping as the one of the significant causes of water loss in the city:

> *"The existence of illegal piping, which despite the significant efforts of our colleagues in the subscribers department and managers… I was manager for 15 years, I was manager in Qarchak, Bagherabad, Kazemabad, about 11 years I was the Pakdasht manager, really one of our biggest concerns is the illegal piping" (Interviewee SH, SEW Co).*

As mentioned by one of the company's managers, this particular problem belongs to Varamin, and confronting this problem seems has a long road ahead because of some cultural and religious considerations. People using

the relationship for their illegal piping as highlighted by one of the company's experts:

> *"I was in the night watch. When someone called that his water pipe was broken, we found out that his water connection was illegal, then we disconnected the water connection, after a while he re-installed it by using the people he knew in the company and he is still not paying any water bills" (Interviewee AS, SEW Co).*

As indicated by interviewees, confronting this problem is very difficult for the company. There are several reasons that could be highlighted as follows: Iranian cultural and religious beliefs disapprove of cutting off the water on the people as a shameful behaviour. Varamin is a small city compared with Tehran, and most of the people know each other and as a result the company's employees cannot do their duties completely because they are caught between their duties and their relations with the people they know. In addition, as mentioned by one of the interviewees, some of the company's workers are the ones who are doing the illegal piping for the people:

> *"Our digging workers are earning more from doing the illegal jobs" (Interviewee AS, SEW Co).*

Water supply

Water supply was mentioned by interviewees as a significant challenge for both companies which are under pressure from the population growth, and the increasing water demand. Over the past fifty years, the population of

Tehran has increased about six-fold which is putting a lot of pressure on the water resources. One of the TWW Company's interviewees stated:

> *"Almost Tehran's only problem is increasing of its population; supplying water for this population which is near 1/5 of Iran's population is very hard" (Interviewee MG, TWW Co).*

Tehran has access to the water surface and groundwater. Findings show the TWW Company recently has invested in the development of the water supply network, which is called Tehran water ring plan. One of the interviewees stated:

> *"In this project we upgraded the treatment works and increased the production, and moved the production in the 30 different tanks, we took the increased water to the south of Tehran" (Interviewee MO, TWW Co).*

By operating Tehran water ring plan, the water management of the city reduces the risk of the water disconnection in the city. In addition, this plan provides the city's water consumers with water of the same quality.

Water supply in Varamin is different from Tehran; as indicated by the SEW professionals, Varamin is suffering from the water shortage problem. The city's water is provided only by extracting water from the wells, and the city has no access to the surface water. In addition, the population increase is currently putting a lot of pressure on the water supply of the city. One interviewee indicated:

> *"Varamin had a great population increase in recent years and our water resources are not enough for this population" (Interviewee SO, SEW Co).*

Therefore, providing the water for the city is a big challenge for the company, as indicated by one of the SEW managers:

> *"Providing water is the most important challenge, in my belief saying "the future war is the water war" is true, the biggest job for Varamin is to transfer the water from Tehran waste water treatment plants to the Varamin plain as soon as possible" (Interviewees MR, SEW Co).*

The interviewees mentioned that the company has a plan to get surface water from the Mamlo Dam in Tehran, which could help the city's water resources. However, it seems they are not optimistic in this matter. One manager stated:

> *"I know that our company has a programme for getting water from Mamlo, but we always have the concern, once one of the company's superior managers was talking in a meeting, he told us that the Mamlo Dam belongs to the people of Tehran, why does Varamin put itself in the middle? I don't think the Mamlo Dam's water is going to reach to Varamin, because of Tehran with its growth and its needs" (Interviewee SO, SEW Co).*

The excessive use of groundwater is causing a drop in the groundwater level in Varamin. This problem of water level drop is leading to the further problem of subsidence phenomenon in the city. One interviewee mentioned that:

> *"One of the biggest challenges of Varamin is the drop in water level of groundwater. This means we annually each year have something around a one metre drop in the water level. One time, our water extraction was from the depth of 100 metres, then became 150 metres, 200 metres, and now is from 200-350 metres". (Interviewee MR, SEW Co).*

Another interviewee stated that:

> *"Taking water from the plain of the Varamin for agriculture and for drinking with wells is causing subsidence phenomenon, this is one of the concerns of the city's authorities." (Interviewee SO, SEW Co).*

One interviewee blamed the illegal use of groundwater by the agricultural and industries around the city:

> *"Our other challenge is land's subsidence, illegal wells are too many, farms and industries are using illegal wells. Taking more than feeding the underground resources is causing a lot of problems for us. For example, a well that could supply water for 15 years, sometimes last less than two years. The wells are becoming muddy and crooked. This imposes a great cost to our company" (Interviewee SH, SEW Co).*

As mentioned in Chapter 3 p60, the water management of Iran has moved towards modernisation during the last century constructing dams and using deep wells. In the last decades, due to uncontrolled groundwater withdrawal and improper irrigation system, groundwater table has been decreased sharply (Khakbazan Fard et al 2012). This problem has been highlighted by the Director of the Iran Geological Organization in an interview published in Ettelaat daily newspaper (2013):

> *"Due to the unreasonable extract of groundwater, Varamin plain is facing the land subsidence. According to the surveys until 2010 the land subsidence was 17 cm per year, at present, this figure has reached 36 cm per year. Thus, Varamin plain is going down a metre each three years. If this issue is not prevented Varamin plain groundwater reserves will be lost forever".*

As indicated in Chapter 3 p65, with the continued water shortage in Iran, the practical approaches of water harvesting systems such as qanat, are getting more attention. The water system of qanat is an ancient approach of water harvesting system. This approach is well-matched to certain geographical areas such as Iran, with arid and semi-arid climate. Some academics in Iran believe that qanats could be an alternative alongside the current water supply to help the future water scarcity. For example Rahnemaei et al (2013), stated that if the current water situation is maintained, Iran will be running out of suitable sites for dam construction in less than 150 years. Therefore, the sooner we realize the virtues of qanats, the better (Rahnemaei et al 2013).

In the past, the city of Varamin's water was provided by a network of the qanats, but most of them are abandoned, and now city depends only on the groundwater resources. During the research interview, one of the water professionals in the Varamin mentioned about the incidents regarding the qanats in the city. This indicated that the qanats water system had been abandoned without specific organisational responsibility:

> *Interviewee RA: one the basic problems of the Varamin is the existence of the old qanats*
>
> *Interviewer: Are they still operational?*
>
> *Interviewee RA: no, they are not active, they were there and the houses are built on them, this is a major problem that maybe 90% of the damages belong to the existence of the qanats under the buildings.*
>
> *Interviewer: what sort of problems?*
>
> *Interviewee RA: I have seen the incidences maybe 4 or 5 times; in one case the lamp post completely collapsed into the ground. The lamp post high is at least 6 metres,*
>
> *Interviewer: had any casualties?*
>
> *Interviewee RA: no, it was a leakage and we were doing our digging job which the lamp post collapsed. I think it took 6 to 7 lorry of wastes to fill the qanat and even that could not fill that completely*
>
> *Interviewer: couldn't these qanats be used?*
>
> *Interviewee RA: In past; you know Varamin is one of the ancient cities, the qanats were there and the city has been*

developed, I do not know about these things, the municipality had issued the permission of construction based on their instructions.

Water quality

Maintaining water quality in Tehran and Varamin is one of the significant challenges. In the past, one of the issues related to the water quality was the different water quality in different parts in the city of Tehran, and as it is indicated by some of the interviewees, this issue was taken for consideration, and the company invested money in the water quality. The company wants to supply the whole city of Tehran by the same water quality (not necessarily better quality). It seems that the company's top managers are very proud of what they have done. One of the senior managers indicated that:

"We have done the greatest job since two and half years ago, for the first time in the history of Tehran, we made the same water quality in the north and the south of the city" (Interviewee MO, TWW Co).

In relation to Varamin, the city's water quality is poorer than Tehran. As mentioned in Chapter 3 p74, Varamin and its towns are located in the Varamin Plain, and as Tehran geographical situation is higher than Varamin, the wastewater flows from Tehran towards Varamin. This is causing problems such as water contamination, and in recent years the Town of Qarchak, which is closer to Tehran, has found that their groundwater has

become brackish. One interviewee remarked that Tehran's wastewater was causing the problem:

> *"It is because Tehran's wastewater has entered to the plain of Varamin, and because of it the Qarchak water is brackish" (Interviewee AS, SEW Co).*

A few years ago, the poor quality of water had caused the political issues in Qarchak and people were opposing, and wanted their water quality to get better as mentioned by one of the interviewees:

> *"In the city of Qarchak, the political situation came up and the company installed a desalination plant" (Interviewee MR, SEW Co).*

However, according to one of the interviewees, the management of the company has been influenced by the political issues, and did not choose the right way for tackling the problem. The interviewee believed that the company's job of installing the desalination plant for the city was a short term solution to keep the people quiet. The company could have done a better job with less money. The interviewee said:

> *"The company used the Reverse Osmosis (RO) desalination technique which almost converts the water to distilled water, it is the purified water. I suggested the Nano method, that I had a lot of information about. In this method the water passes through the* membranes. The *germs and bacteria are filtered as*

> *well the salt. This method is cheaper than purifying the water" (Interviewee AS, SEW Co).*

Despite *Qarchak* problem regarding the water quality, as indicated by one of interviewee, there is no investment or priority investment plan for the city's water quality. The interviewee said:

> *"Water quality is the next priority, well, firstly the quantity should be solved then the company could go on the quality matter" (Interviewee SO, SEW Co).*

One of the recent investments in TWW Company is in the city's wastewater system, and also from the company's professionals point of view is a priority investment. One of the TWW Company interviewees highlighted that:

> *"If I am given the money, I would certainly invest it on the development of the wastewater network" (Interviewee MI, TWW Co).*

Similarly, the SEW Company interviewees mentioned investment in the wastewater system in the city of Varamin, and indicated that as a priority investment for their company. One of the interviewees highlighted that:

> *"If we could transfer the wastewater from Tehran, or if we put our waste water system into the operation in our city, it would be a very big step in helping our water resources" (Interviewee MR, SEW Co).*

Investment in new technologies is indicated by the interviewees as one of the significant investments in both companies. One interviewee in TWW Company said:

> *"We want to take the establishments, the equipment, and the water distribution network towards being an automated system, we want to make the system intelligent, which could decide by itself, for example to supply the water, turn on the wells" (Interviewee KA, TWW Co).*

The professionals in the SEW were very excited about the telemetry technology and see that as a necessity for their company.

> *"Telemetry is highly demanded by the SEW Company, for example, the operator in a room could control the whole city's pressure, if there is a problem, it could be seen from the monitor, but now as we constantly should control with calling, and there are guards of the wells who are controlling them. Telemetry is a systematic way, and surely would be very successful" (Interviewee RA, SEW Co).*

6.2.2. Institutional challenges

This section discusses the institutional challenges of financial problems and water price. Managerial challenges will be examined later in this Chapter (section 6.3).

Financial problems

Financial matters are indicated to be one of the challenging issues of TWW and SEW companies. The findings show that both companies' performance and projects are affected by the financial problems, and many proposals and projects are being held back or rejected regarding the financial problems. The TWW Company's top managers indicated their attempt to find money resources, especially from international funding and banks to supplement their governmental budget allocation. The financial problems had been affecting the TWW Company's projects as indicated by one of the managers:

> *"As an expert one of my jobs is to search for the best solution; more than 90% of our suggestions are facing the closed doors such as we do not have the budget which is discouraging" (Interviewee FA, TWW Co).*

Another interviewee said:

> *"The Tehran Regional Water company for providing its finance is selling water because it has a financial problem. If the government had provided the company's budget, this would not have happened" (Interviewee NP, TWW Co).*

As indicated by one of the senior managers, the company was undertaking actions for finding the financial resources for funding their projects. The interviewee highlighted that:

> *"For network reconstructing and building the wastewater network, we are using financial resources of the company and*

> *governmental resources, and also using the funding of World Bank and Islamic Development Bank" (Interviewee NP, TWW Co).*

Similarly, the SEW Company has financial difficulties; one interviewee highlighted:

> *"We have budget only for the investment projects, development of the network, building the water tanks and things like these; for the other things, the government says you should take it from the people" (Interviewee SH, SEW Co).*

Recently, as highlighted by interviewees, the SEW Company started to work with the private sector for implementing its projects. Under the new regulation, the government pays 85% of some of the projects if the company gives the job to the private sectors. One interviewee highlighted that:

> *"We employ the contractor and they start to do the job, the money is assured to be provided by Government. This is new and we are doing for the first time in the country" (Interviewee MR, SEW Co).*

However, some interviewees had doubts about the appropriateness of doing these kinds of projects. They ask why the Government gives the money to the private companies and not their water company. The Government answer is because they want the private sector to be active, but in the company, they

think it is not logical and it could lead to corruption. One of the interviewees said:

> *"How the private sector could be functioning when they get the money as a loan from Government? In this way the project, instead of costing 20 billion Rials (Iranian currency), surely would be costing 40 billion. Is this right? It does not seem logical, I do not know; this is our process" (Interviewee AS, SEW Co).*

Water price

As indicated in Chapter 3 p77, Bagheri and Hjorth (2007) highlighted that in Iran, the gap between the cost of water production and the water tariff could be rooted in the policy of subsidies. Now the reform of subsidies is one of the recent water policies in Iran that has been implemented from the year of 2010. According to Hassanzadeh (2012), in March 2010, the Iranian parliament ratified the Targeted Subsidies Reform Act calling for a gradual increase of energy prices within a five-year period (2010–2015), and for water, the prices are to be set to increase to cover full cost price. After 3 years of starting Subsidies Reform, the findings of this study highlighted that water price is still one of the Tehran water management challenges, and interviewees in both companies of TWW and SEW indicated that the water tariffs are not balanced with their needs. As mentioned by the interviewees, the water price is determined by the government. One of the TWW interviewees stated:

> *"The water tariffs are given to us by Government, and these tariffs are not balanced with our needs, TWW is sustaining a loss" (Interviewee MI, TWW Co).*

In the same way one of the SEW interviewees stated that:

> *"The price is not in the company's authority, because we are a part of the government. Actually, our company's duty is to follow the Government's rules and pricing, they tell us 'SIR THE WATER PRICE SHOULD BE THIS' do you know what I am saying" (Interviewee NA, SEW Co).*

The findings show that the SEW Company has difficulties in getting the water charges from the water consumers in the city of Varamin. A lot of water consumers in Varamin ignore the water bills and they have big outstanding debts for their water bills. The interviewees from the SEW Company highlighted that the company has problems in getting the water bills money from the people. One interviewee remarked:

> *"Our income is from water price, people do not pay the water bills, they think water should be free, people have maybe 4 billion Rials outstanding money for their water bills, well, what could we do?" (Interviewee AS, SEW Co).*

Another interviewee indicated:

> *"Our challenges with people, they do not pay their bills on time, if people do not pay on time we would be in a big disaster" (Interviewee SH, SEW Co).*

The above issues raise questions about the recent water price increase policy for covering the water cost production, especially in the poor area of the Varamin. It also raises questions regarding the effectiveness of the subsidy reduction policy in relation to the reduction of the water consumption. Why are a lot of people in Varamin ignoring their water bill?

The Next section discusses the level of interactions within the companies which is in close relation with the institutional challenge of management.

6.3. Companies' internal management

The interviewees highlighted the internal management of the companies as one of the significant challenges. The findings highlighted the lack of information sharing and interaction between the different levels within each company. The middle managers and the experts believed that management of their companies is traditional, and resistant to change, and the weakness of the management is letting their companies down. One middle manager remarked:

> *"The most challenging issue is the weakness of the management; the management is resistant to change" (Interviewee FA, TWW Co).*

One of the TWW Company's experts highlighted:

> *"In fact the city of Tehran has no management on the distribution of its water; the green spaces are under supervision of municipality. The water wells used by municipality for*

> *watering green spaces are very close to each other" (Interviewee MI, TWW Co).*

Similarly, the management of the SEW Company is criticised by the interviewees for being resistant to changes and not having enough knowledge in water related issues, and also being influenced by the political issues. The interviewee highlighted:

> *"The MP of the city was pressurised by people to do something about the water quality, he wanted to do the job, people were opposing, and it was a year to the election, he said that something should be done, we told that there are other methods, let us to find out but it takes some time…they did not allow us and took the opportunity from us" (Interviewee AS, SEW Co).*

The interviewee added:

> *"Management is completely traditional, the new methods have no buyers at all, the managers completely resist the changes, well… unfortunately the gentlemen have no knowledge" (Interviewee AS, SEW Co).*

The findings show that some of the middle managers and the experts of the companies believed the changes of the companies' managers are motivated by the political issues, rather than the appointees' knowledge of the water issues. One interviewee in the TWW Company said:

> *"The changes in the company's management are very annoying, thecompany depends on a person. A manager comes with different views and as a result, it is possible the present working projects end up unfinished" (Interviewee FA, TWW Co).*

Another interviewee from SEW Company stated that:

> *"Our biggest problem is the lack of compliance regarding the regulations in selecting the authorities, maybe the biggest concern in our company is the relationships selections, the authorities selections are based on the relationships" (Interviewee AS, SEW Co).*

The findings highlighted that the senior managers rely on the middle managers' reports and assessment for making their final decisions. Most of the middle managers believed that they made contribution to the decision making in the TWW and SEW companies. The middle managers' contribution to the decision making was cited by half of the interviewees. One interviewee stated:

> *"There are some management issues, for example, when the new senior managers come to the company, they do not know what has been done, or not been done in the previous management. We prepare the analytical reports and transfer to the senior managers" (Interview MI, TWW Co).*

One interviewee from SEW Company stated:

> *"In our section, we suggested to do District Metering Area (DMA), then Tehran Central Energy Department (in Ministry) wanted us for a meeting, then we went over there and took the consultant with us and had justified that this is a need for us, then they accepted and the contract was confirmed" (Interview SO, SEW Co).*

It appears that there is some collaboration regarding the decision making process, particularly in the upper management of the companies. The findings indicated that the decision making is a process of the information mainly between the senior and middle managers of the companies. The supporting argument could be the process of decision making does not entirely depend on the senior managers, and they seek the information from the middle managers of the companies. However, the other members of the companies think that they are not being heard and they are not involved in the companies' decision making process, because they are in the lower rank in the company as one of the interviewees said:

> "*If I had a higher position maybe my proposal would have been considered for implementation" (Interviewee AS, SEW Co).*

Overall, in terms of the institutional flexibility, neither of the companies could be considered as adaptive (Figure 6.3). As indicated in Chapter 2 p29, the institutional flexibility meant by the concept of AWM is to move from technical infrastructure and by promoting more human interaction. Institutional

flexibility is allowing social feedback and adjustment between different levels within the institutions by sharing knowledge and information. This Chapter investigated the companies' institutional flexibility by highlighting the two issues of companies' responses to the water challenges (technical and institutional), and the companies' internal management (interactions between different levels within the companies). In level of companies' responses to their challenges, the findings showed that the companies have mostly technical flexibility, and the process within the companies is mainly addressing the technical problems (e.g. water loss control). In level of internal management, the findings illustrated the lack of interactions between different levels within the companies. The findings highlighted that despite some interactions between the top and the middle managers, other members are not involved in the companies' decision makings. However, it seems there is a potential among the water professionals to move towards more interaction within the companies, by moving towards gaining and sharing more social knowledge and information. This indicates the interest to move towards more adaptive strategies among the water professionals. One of the SEW Company's interviewee mentioned the necessity of an information bank to gather company's information, which means more internal collaboration in the companies alongside the technical issues is needed. For instance, the interviewee indicated:

> *"In our water company, one of our problems is that we do not know the kind of the pipes, we do not know when the job has been done, first of all, we need to have an information bank" (Interviewee SO, SEW Co).*

Another interviewee from TWW Company highlighted that the company needs to depart from the supply management. The interviewee stated that:

> *"If we spend 1/10 of our budget on the awareness, our view would be changed from supply to the consumption management, this view could change a lot of problems" (Interviewee MI, TWW Co).*

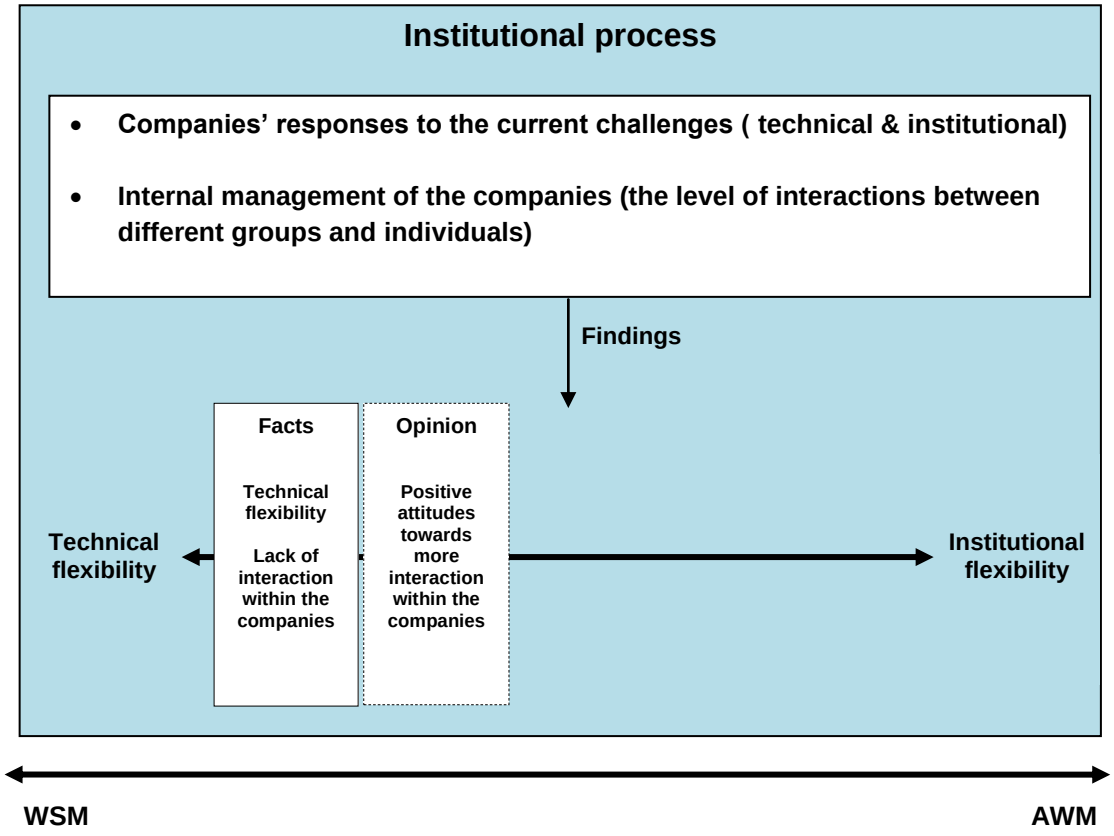

Figure 6.3 TWW and SEW institutional flexibility

Figure 6.3 presents the current status of companies regarding the institutional flexibility. As can be seen in Figure 6.3, the companies are investing more in technical challenges, and there is a lack of interaction within the companies' internal management, which are the characteristic of

the WSM. However, water professionals' opinions showed that there is a potential to move more towards adaptability in the companies.

6.4. Chapter conclusion

The Chapter investigated the water companies' institutional flexibility in Greater Tehran. The findings showed that the water management in Tehran has been facing serious technical and institutional challenges. While addressing the technical challenges is the main focus of the water management, the institutional challenges are not getting enough attention from the companies' decision making. The reason could be that the growing of the urbanisation in Tehran province, is putting a lot of pressure on the body of the water management to provide the increasing water demand. The SEW Company institutional problems such as water loss are associated closely with particular social/cultural issues of the city of Varamin. The Chapter highlighted that the current situation are not close to the adaptability. In fact, the findings indicted that the companies are showing the characteristics of WSM by addressing technical challenges and the lack of interactions in the companies. The following Chapter will turn to the third AWM characteristic, public participation.

Chapter 7

Public participation

7.1. Introduction

This Chapter discusses the key issues related to the AWM characteristic of public participation. The Chapter provides a detailed description of data collected from the water companies and water consumers, concerning research objective 2, that was: to examine the adaptability of the policies and strategies in Greater Tehran. As discussed in Chapter 2 p31, public participation is an important requirement of AWM. Accordingly, the Chapter is intended to investigate and evaluate the public participation characteristic, and to highlight whether the public participation could be applied in an effective strategy in Greater Tehran water management. The Chapter analyses and discusses the public role in water management considering water companies and water consumers' perspectives (Figure 7.1).

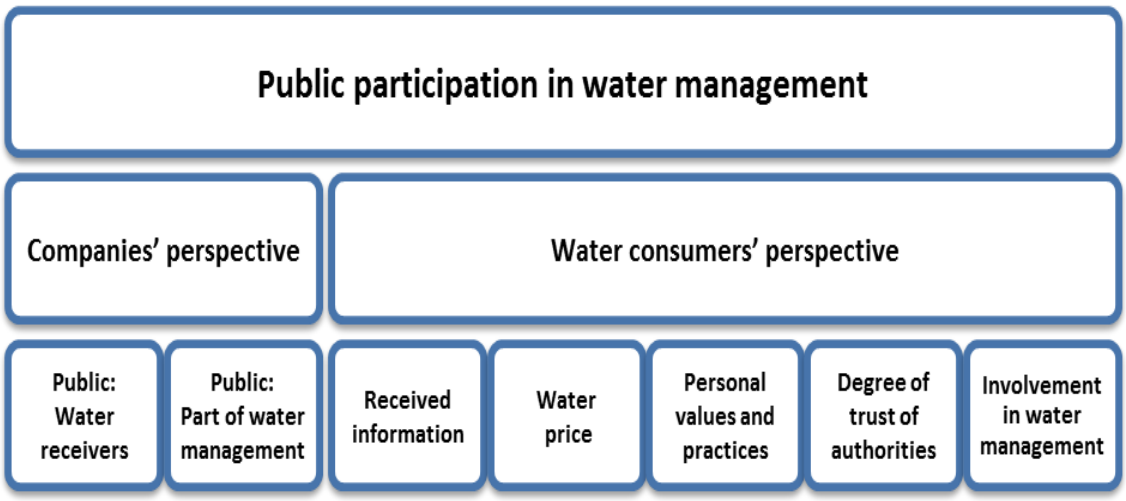

Figure 7.1 Companies and consumers perspectives

The Chapter starts by examining the water professionals' perspectives regarding the people's role in the water management. This is followed by exploring the public's perspectives on their role in their city's water management.

7.2. Public participation in water management

7.2.1. Companies' perspective

As can be seen in Figure 7.1, the companies' perspective on the public role in water management is investigated through two categories. The first being the public as water receivers, and the second category, the public as part of the water management, which are the views of the public role in water management in the WSM and AWM respectively. While the WSM considers the public as water customers who receive water and services from the water companies, AWM sees the public as a part of sustainable water management (see Chapter 2 p31).

The interviewees in the water companies of TWW and SEW were asked to address if the investments/initiatives in their companies had any interaction with the water consumers. The aim of the question was to obtain the view of the interviewees on the public's role in water management, and how they see the water consumers: as the water receivers or as a part of water management. Findings indicated that the TWW Company sees their water consumers as the water receivers. The company wants to provide the water consumers satisfaction by providing them with water 24/7 with satisfactory quality. One of the company's interviewees commented:

> *"The consumers want to have the water on time and in the best quality and we are doing that. We provided water 24/7 for everybody in all areas of the city, our intention is that the water is to be there with the acceptable quantitative and qualitative standards" (Interviewee KA, TWW Co).*

In addition, the water professionals of the company do not see the public participation as a necessary element for the city's water management, and as indicated by one of the interviewees, the company assesses its services by water consumers' reactions to the services they receive. One interviewee stated:

> *"We do not have cooperation with water consumers; we understand the people's opinions from their reaction to the received services. If in an area the water pressure is low, consumers would be unsatisfied and they communicate that to us. Therefore, we adjust the water pressure in the network, or provide the water resources for that dissatisfaction" (Interviewee AR, TWW Co).*

The findings in the SEW Company indicated the similarity with the TWW Company. Most interviewees in the SEW Company mentioned the public as the water customers who want to buy the water and services from their company, and the company wants to provide them with the best. One of the interviewee said:

> *"See, our biggest customer is the public, our existence depends on them, we extract water from the wells and give it to the people, if people were not there we wouldn't be here now, for our survival, it is necessary that people be pleased with our services" (Interviewee SH, SEW Co).*

The findings suggest that in terms of public participation, neither of the companies can currently be seen as 'adaptive'. Both companies are considering people as the water receivers, and companies are providing them with their water related services. However, the findings regarding the SEW Company highlighted that there is recognition of the importance of the public role in the water management. The company' management is interested to involve people in the city's water management. The SEW Company has some collaboration with the public in the aspects of water loss and consumption management. The children in the nurseries and the housewives are their target population whom they have planned to work with. One interviewee indicated:

> *"We have cooperation with people in some special parts, for example in consumption management, reduction of water loss and optimisation in water use. We established a group in our company in the past few years now, which is called water advocates.*
>
> *Interviewer: water advocates?*
>
> *"We have water advocates in the education way, we started to educate from the bottom of the society, from nurseries"*

Interviewer: Is this being done in Varamin?

"Entirely, it is being done in the SEW Company for a few years now. We started these educations for kids in nurseries. We educate children about our water extraction, transfer, and distribution. We had several meetings with housewives. We gathered some of the local housewives and talked to them about water consumption management" (Interviewee MR, SEW Co).

The SEW Company's interviewees believed that more interaction with the public could solve some of the company's problems. One of the company's interviewees state that:

"If we explain things to people and inform them, a lot of our problems could be solved. A part of our problem is the lack of public information" (Interviewee SO, SEW Co).

The findings indicated that the SEW Company had more interaction with the public. As indicated above, the company has programs for more interaction with people to provide them with the information about the city's water situation. The observation (see Chapter 5 p130) of offices that were open to the public in one of the SEW Company's buildings, supported the positive attitudes of the company towards adaptability.

7.2.2. Water consumers' perspective

This section draws on data from the water consumers' interviews. Examining Tehran and Varamin's people's view on their role in water management indicated five main factors. Consideration of these factors could be an advantage in water management decision making. These factors are: received information, water price, personal values and practices, degree of trust towards water authorities, and public interest in involvement in water management (Figure 7.1). This section discusses these factors.

Received information

The interviewees were asked: Did you receive any information about your city's water management from your water company? Have they ever noticed any public information program in the media, or received any education from authorities on water? The aim of the questions was to obtain the view of the public regarding their water companies and how they see their role in their city's water management.

The majority of interviewees indicated that they did not receive any information from their water company. One interviewee said:

> *"No, nothing, they put just a warning on our water bills" (Interviewee 32, Tehran).*

Another interviewee stated:

> *"No, there was not any, we have a very small water office which opened few years ago, they just issue water bills" (Interviewee 65-2, Varamin).*

A few of the interviewees mentioned receiving some information from their water company, which were mainly about the water companies' request for saving water. One interviewee said that:

> *'There is always a repeated sentence on the water bill about saving water" (Interviewee 29, Tehran).*

Another interviewee indicated that:

> *"*It was about the water saving on a piece of paper*" (Interviewee 64, Varamin).*

The participants were also asked whether they received any information from the media. Most of the interviewees stated that they received some information from the media, mostly about saving water. Some of the interviewees believed that the information had an effect on them. One interviewee said:

> *''These programmes surely had effects, we used to wash our backyard at least once a day, but now we lessen our yard washing to once per week'' (Interviewee 55, Varamin).*

One interviewee said:

> *'I heard about the water saving devices on TV which make the water use less" (Interviewee 34, Tehran).*

Some respondents indicated that the programs on TV mostly influence kids. One interviewee highlighted:

> *"It was a children's program regarding water saving, for example, closing the tap during tooth brushing. It had an effect on my kids" (Interviewee2, Tehran).*

Another interviewee highlighted that:

> *"It was my childhood program, and still is in my mind" (Interviewee 62, Varamin).*

However, some of the interviewees indicated that the media information is boring and do not tell anything special. One interviewee mentioned:

> *"It was very boring, they were retelling the same story over and over" (Interviewee 29, Tehran).*

Another interviewee indicated that:

> *"They do not say anything special, they show how water is wasted,* they *don't mention the methods of water saving (Interviewee 65-1, Varamin).*

The findings illustrated that, from the public perspective, their water companies are not giving them enough information. Also, that the media is the public's way of receiving some information regarding the situation of their city's water. Overall, it appears that people expect to receive more information from the water companies and the media:

> *"People should know more about the water situation, the awareness in this relation is little, people do not get affected by*

the programs, they should not assume that people are stupid, and give them the right information" (Interviewee 30, Tehran).

The lack of information was highlighted by the issue of water meters in the city of Tehran. As the result of the population increase and the changes in the people's life style, a lot of Tehran's residents are living in block apartments or residential towers now. As indicated by the interviewees, one of their water related problems was the shared water meters. This issue sometimes causes problems for the people and they believe if they had separate water meters from their neighbours, they could manage their water usage in a better way. One interviewee indicated that:

"I live in an apartment block; I have to pay for other careless people's water use. It would be very good if I had a separated water meter" (Interviewee 26, Tehran).

Another interviewee said:

"The water meter should be separated like the electricity meter. Each flat should have its own water meter. In this way I can find out how much my water consumption is" (Interviewee 2, Tehran).

I had the opportunity of accessing the water professionals at the same time as interviewing the public, and I discussed with them the issue of the water meters. I mentioned this particular problem with one the TWW Company's managers. I have been told that there are some conditions for providing

separate water meters to the buildings. Separate water meters could only be done for the buildings that; are up to three floors (considering the water pressure), have enough space in the building's entrance to make the water meter installation possible, and have separated hot and cold water piping for each apartment (some block apartments are provided with a hot water supply from a central source within the buildings). None of the public interviewees knew about those conditions that I was given by the company. In fact, considering the company's conditions, most of the people I had interviewed could not have had a separated water meter and they were not aware of it. This highlighted the lack of interactions between water companies and their water consumers.

Regarding water saving devices, findings indicated that the majority of the interviewees were interested to use the water saving devices; however, most of them mentioned that they would use them if they get the assurance of the effectiveness of the devices. One interviewee stated that:

> *"If I see that is a good thing and it would make efficient use of water, I would use it" (Interviewee 35, Tehran).*

In addition, in Varamin, interviewees pointed out that if the water saving device had a reasonable price they would obtain it. One interviewee indicated that:

> *"If it was affordable, yes, I would use it" (Interviewee 63, Varamin).*

The findings show that some of the participants were already using the water

saving devices in their houses. One interviewee highlighted:

> *"We use a special shower head in our bathroom, and also for the kitchen tap. It is called 'Pressure breaker' (Interviewee 25, Tehran).*

Another interviewee indicated that:

> *"We changed the whole of the building's taps to lower our water use" (Interviewee 55, Varamin).*

On the other hand, the findings indicated a lack of knowledge and information about water saving devices, and the interviewees were mistaking these devices with the water filtering equipment. One interviewee from Varamin indicated that:

> *"I have them in our kitchen sink and in the washing basin in the bathroom*
>
> *Interviewer: is it useful for saving water?*
>
> *I think…it is for collecting the germs; when I open it, it is full of sands" (Interviewee 60, Varamin).*

Findings show the positive attitudes towards using water saving devices. However, most of the interviewees stated that they would like to use the water saving devices if they were affordable and proven to be effective in saving water by the authorities. The findings highlighted a lack of information among the public regarding the water saving devices.

Water price

As mentioned in Chapter 6 p164, water price is one the challenges of Tehran and Varamin. The new policy regarding the cutting of the water subsidy started in 2010. During the past three years, the water price gradually increased and an even higher water price is underway. The majority of the interviewees indicated the water price as the main motivation for their water saving. This indicated that the recent water policy of increasing the water price seems to have an effect on the water consumers. One interviewee highlighted:

> *"Why keep the water tap running while you are doing something else, this is not economic and increases household costs" (Interviewee 67, Tehran).*

Another interviewee stated:

> *"I want to reduce my water use, because of the increasing water price, it is not that much but I want to be economical" (Interviewee 61-1, Varamin).*

However, as highlighted by some respondents, saving water for high price was for a short time and they went back to the same water usage routine as they had before:

> *"Because the water bill was high I tried to use less water but it did not work, again the water bill came high. I could not do that anymore, it was very hard" (Interviewee 62, Varamin).*

The findings demonstrate that most interviewees in Tehran did not change their water use habits following the price increase. Especially in the north of Tehran where people are wealthier than other parts of Tehran, it seems people do not care much about the water price increase. One of the interviewee from the north of Tehran said:

> *"Here, some people use drinking water for their swimming pools because they are paying for the water, it's okay for them to use water for any purpose they wish" (Interviewee 25, Tehran).*

Compared to Tehran, the city of Varamin water consumers were more concerned about the water price. Most of them indicated that they use less water due to the water price increase. According to Behtas (2009), Varamin is considered as a deprived, or under-developed area, and the findings suggest that those from a lower socio-economic background are more affected by the water price increase, and they feel they have to change their water use behaviour. One interviewee said:

> *"The price is too much, they should make it less, since the bills have gone up, we use less water" (Interviewee 64, Varamin).*

In relation to the water price increase, and the age of the water consumers, the findings show that the youngest people under the age of 30 did not change their water use routine due to the recent water increase price. This could be related to whether or not they are responsible for the water bill.

Some of them who were living with their parents indicated they do not know anything about the water price. One interviewee said:

> *"I do not care about the water price, I do not pay the bills, my dad always says close the tap, turn off the light. He is worried because he pays the bills" (Interviewee 65-1, Varamin).*

Another one mentioned:

> *"I do not know about the water price, my dad is paying for it" (Interviewee 61-2, Varamin).*

Overall findings show that the recent water increase caused people to use less water; however that could be a short term result. Taking into account that most people in the city of Tehran did not change their water use pattern regarding the water price increase, and the fact that most young people under the age of 30 in both cities did not care about the water price changes, undermines the effectiveness of the water increase policy. Findings suggest the water price has more influence on the people's water use behaviour with those of a lower socio-economic background; considering this point, the fairness on the poor people is questionable.

Water practices and personal values

The majority of the interviewees believed that they have some personal ways of saving water. Figure 7.2 shows the different practices used by the interviewees. The mentioned practices by the interviewees were: taking shorter showers, reusing the water from washing vegetables, reducing car

washing, fixing leakages, closing the tap during dishwashing and teeth brushing, planning for using the washing machine, and reducing backyards washing.

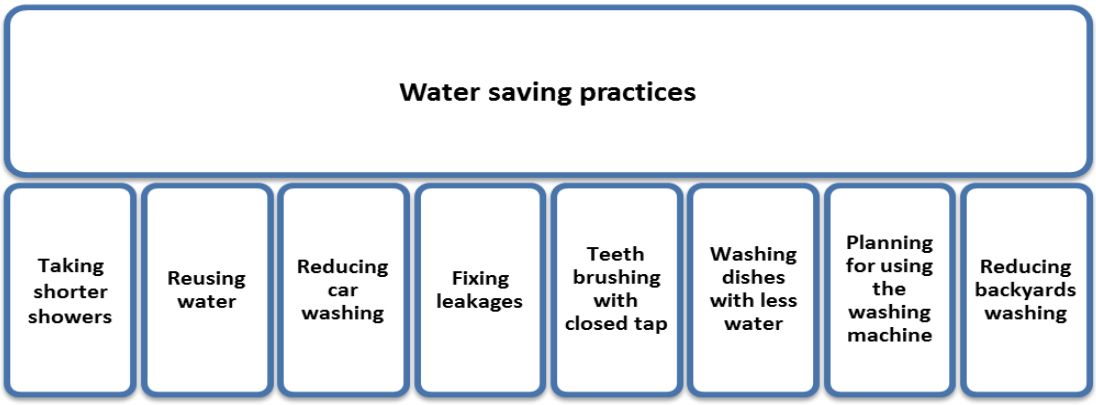

Figure 7.2 Water saving practices mentioned by water consumers

One interviewee highlighted that:

> *"I try to use the washing machine only two times per week by separating the different colour clothes" (Interviewee 28, Tehran).*

Another interviewee indicated that:

> *"I use the waste water from washing vegetables to water my flower pots" (Interviewee 2, Tehran).*

One interviewee stated that:

> *"Recently, I have bought a head for our hose in the back yard which could be controlled by hand and make the water use less" (Interviewee 59, Varamin).*

The personal values in this study refer to the participants' feelings and beliefs that lead them to save water. Individual interviews explored the personal values of the interviewees that provided the motivation for their water saving activities. As highlighted by the interviewees, two of the issues findings emerged; the primary motivation for saving water was thinking of others and the religious consideration was the secondary. For the interviewees, the value of thinking of others included "to care for other people". The importance of this value is indicated in the following quotes from both cities of Tehran and Varamin as their motivation for saving water. One interviewee said that:

> *"I saw the people that had a lot of water problems, sometimes their water was cut off for two or three days, That is why my feeling is making me save the water" (Interviewee 28, Tehran).*

Another Interviewee indicated:

> *"The water resources are not only for us, it belongs to the next generation" (Interviewee 59, Varamin).*

Second, the religious consideration was indicated by a few interviewees as their motivation for saving water. One interviewee highlighted:

> *"For me it's a god related matter, I don't want to waste the water" (Interviewee 16, Tehran).*

Degree of trust towards water authorities

Interviewees wanted the water company to give them the right information. One interviewee highlighted:

> *"If they give the people the correct information, it could help the water management, but if the information is not correct, nothing could be done and we always stay in the same situation" (Interviewee 29, Tehran).*

Most participants believed that their water company is not connected with them and they do not receive enough information from the city's water management. One interviewee mentioned that:

> *"In the case of water management, no information is given at all, this means we do not know anything, the only thing the water company is good at is getting money, for example, my water meter exploded in the cold two years ago, they said it is not their problem. The culture should be changed; the most important thing is they do not look at consumers in a good way" (Interviewee 55, Varamin).*

People do not trust the water companies to give them good water quality. The quality of the water piped into their homes is indicated by both cities' residents as an issue of concern. Findings show people believe that they are not given the correct information regarding the water quality, and the uncertainty about the safety of water means that they use filtering equipment in their houses. It seems there is a lack of trust towards water companies regarding the issue of the water quality. Some people believe that the water is not safe and causes health problems:

"They should think about the people's health, you think where all these diseases and cancers are coming from, these are caused by the water. If the water company was careful and had the sympathy with the people, these things would not be happening,

Interviewer: aren't you sure about water safety?

No, I am not, I use the water but I am not assured of the water quality, I do not know what is in the water" (Interviewee 51, Tehran).

The water quality seems to be more problematic in Varamin; the majority of interviewees in the city of Varamin mentioned that the most important problem of their city is the poor quality of the water. People want their water company to provide them with better water quality. One interviewee said:

''The water company should provide better water treatment, a lot of people have kidney stones, you think what is the reason for that, it is because of the water" (Interviewee 60, Varamin).

Another interviewee stated:

''The authorities could track and solve the area's water problem faster, water is salty, its sediments are high, I do not know what is in the water, I only know that the water has problem'' (Interviewee 58, Varamin).

A few years ago, the SEW Company, under public and political pressure, conducted a fast and temporary solution to solve the poor quality water in Qarchak, one the small towns of Varamin (Chapter 6 p158). Now people of the town say the problem is the same as before, as mentioned by one of interviewee the water became better for a short time, and now it is bad as before:

> *"Here, the water was very salty then they put one of the big industrial treatment plants, for a short period of time, the water was very good, then I do not know the details, the quality is almost the same as before" (Interviewee 55, Varamin).*

The mistrust of the water companies is indicated by the public of Tehran and Varamin. One interviewee indicated that people are using filtering equipment in their houses because they are not sure of water safety. One interviewee indicated that:

> *''We know that the water is polluted, if the company was caring for people, they should have told people that the water is polluted'' (Interviewee 49, Tehran).*

Another interviewee said:

> *''Not only me, but everybody is saying the water is well water [underground water from an aquifer], people use filtering equipment for the water, those who cannot afford to buy the equipment buy the water from the water tanks*
>
> *Interviewer: did you ever buy the water from water tanks?*

> *Yeah, before buying the filtering equipment, we used to buy the water, I do not know where they are bringing the water, it is better quality than our piped water. We were using that for drinking and making tea" (Interviewee 57, Varamin).*

The lack of trust was highlighted in the people's reaction to the question related to recycled water. The question asked was: If recycled water was available, would they consider using it? Regarding this question, the interviewer had explained to each one of the interviewees that the recycled water is reusable wastewater, which had been treated to remove solids and certain impurities, and it is safe to use. Almost all of the interviewees showed the hesitation to use the recycled water. One interviewee indicated that:

> *"No, I would never use recycled water, in my opinion wastewater shouldn't be used again, I do not know how the recycled water is going to be treated, if it was available I would not use it" (Interviewee 31, Tehran).*

Another interviewee stated:

> *"I don't want to even look at it" (Interviewee 65-2, Varamin).*

One interviewee suggested that people should not be informed if the water was recycled:

> *"People shouldn't be told by companies whether the water is recycled or not, only after a period of supplying recycled water, should the public be informed' (Interviewee 59, Varamin).*

The public's negative reactions to the recycled water show that there is a lack of information amongst people about the recycled water. In addition, the findings indicate a lack of trust in water authorities. People are not sure if the water companies could treat the water in a proper way. One interviewee said:

> *"It depends on the authorities in this country, if they were reliable I would trust them, if you were in my place would you use the recycled water?" (Interviewee 60, Varamin).*

Involvement in water management

The interviewees were asked if they had any suggestion or anything to say in relation to their city's water management. The vast majority of interviewees expressed their opinions regarding their cities water management that highlighted the people's interest in participating in the water management. Some of the interviewees suggested the separated water pipes for drinking and other water use (e.g. washing and cleaning). One interviewee said:

> *"They should separate the drinking water piping from the other water uses. The company should make these taps available to the people, if they invest in this, it would be beneficial for the company as well" (Interviewee 67, Tehran).*

Some people in Varamin think by separating drinking water piping, they perhaps could get a better water quality for drinking:

> *"Make two separate water piping, drinking and non-drinking water piping, because the water has sediments" (Interviewee 62, Varamin).*

The findings show that people in Varamin are aware of one of the most challenging water problems of their city, and they expect the water company to do the right thing for the city. One interviewee said:

> *"My suggestion to the water company is to update their piping, using the new materials, their worker should know their job and ensure they did not come to gain experience" (Interviewee 55, Varamin).*

The findings indicate that people have a lot of problems regarding the deteriorated water pipes, and they believe their water company does not do its job in a proper way. One interviewee indicated:

> *"Sometime water runs in the streets from the deteriorated pipes, when they come, they do the job by using a plastic band and then put soil on it, a week, a month later the plastic band opens and the problem arises again" (Interviewee 63, Varamin).*

Overall, the Chapter findings indicated that in terms of the public participation, neither of the companies could be indicated as adaptive (Figure 7.3). As highlighted in Chapter 2 p31, AWM encourages the public participation in water management and sees it as a part of water management. The findings showed that the public participation is restricted by the companies' perspective on the people's role in water management. Both companies are considering people as the water receivers and want to provide their consumers with the best related services. However, there is the

potential for the companies to become more adaptive through more interaction with the public, especially in the SEW Company. The company started some collaboration with public (children in the nurseries and the housewives). The interviewees believed that this collaboration could help the water company in the aspects of water loss and consumption management. The findings regarding the water consumers' perspectives highlighted that water consumers have positive attitudes towards taking part in their city' water related issues, and if they have the opportunity, they would like to engage in their city's water management. The public's perspective on the water management highlighted five factors that are affecting their participation in water management. These factors are: received information, water price, personal values and practices, degree of trust towards water authorities, and public interest in involvement in water management. People showed their concern for their city's water by giving their opinions and telling their problems. People expect their water companies to have more contact with them, and they want to be heard and be given the right information. The lack of trust in authorities could affect people's water behaviour. Public opinions regarding recycled water indicated that their attitude towards water re-use is affected by their trust in authorities, and also the information they received. Water consumers' water use could be influenced by the external factors such as water price, however; it is not necessarily a long term water behaviour change. Individuals have their own ways of water saving that could be influenced by their feelings about other people, or their beliefs. Consideration of these factors by the water companies would help them to

move towards more adaptive strategies, and making more effective decisions.

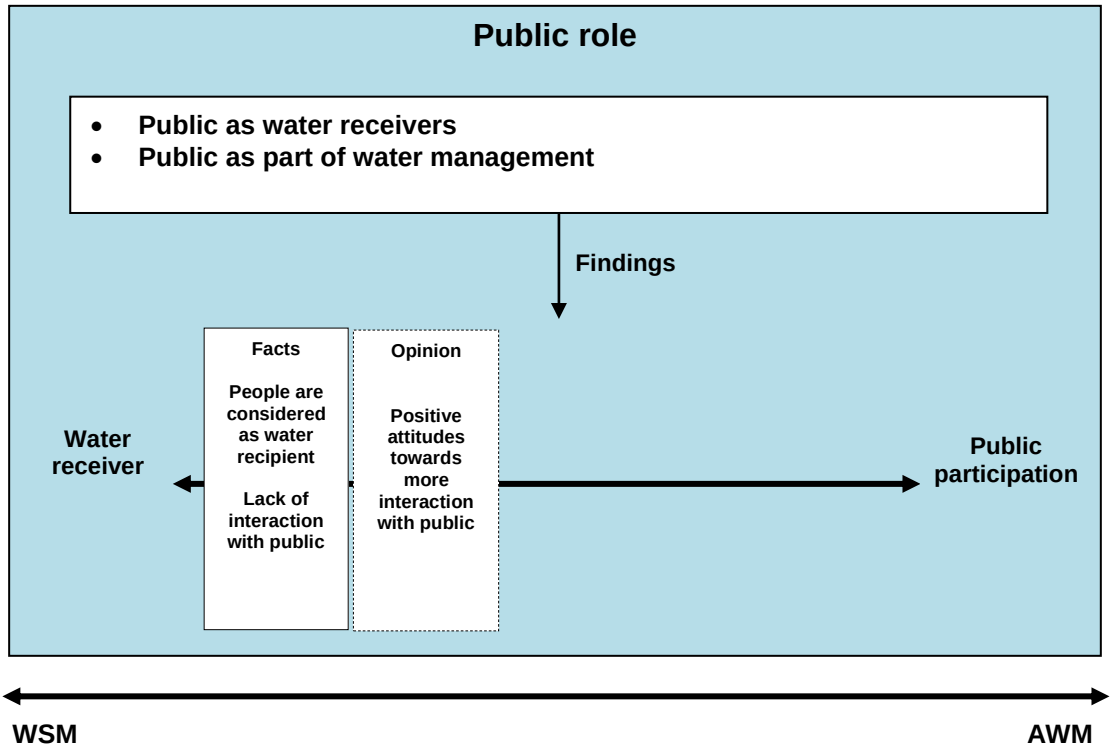

Figure 7.3 Public participation in TWW and SEW companies

7.3. Chapter conclusion

The findings in this Chapter highlighted that in terms of the public participation characteristic, the water companies consider the public as the water receivers, and they do not see public participation as an essential issue. This highlights that the companies could not be indicated as adaptive. However, there are some desires in the companies to have collaboration with the public in aspects of reduction water loss, and the consumption management. The SEW Company showed some positive attitudes towards more adaptability regarding the public participation.

The findings showed that the implemented water policy of water price setting could make people change their water behaviour, but not necessarily for the long term. The findings highlighted that water use behaviour involves personal values and the degree of trust towards water authorities. As mentioned in the Chapter, people's negative reaction towards recycled water is related to the lack of social information between the companies and the water consumers, and also the lack of trust among the water consumers about their water companies. Hence, the lack of social information, communication, and the trust are affecting the water consumers' behaviour. Being adaptive in terms of the public participation has two sides, the water companies, and the public. The Chapter brought to light the people's interest in the water related issues. This is an opportunity for the water management of Tehran to start having a new outlook in their companies' relationship with people. The more interaction with public could be a strategy for better water management in Greater Tehran.

This was the last of the three chapters addressing the AWM characteristics. The next Chapter therefore summarises the findings of the discussion and raises issues about the relationship with the AWM characteristics.

Chapter 8

Conclusions

8.1. Introduction

The overall aim of this research, was to evaluate the extent to which the concept of AWM provides a suitable approach for adoption in Greater Tehran. Accordingly, this Chapter discusses the research findings in the light of the three AWM characteristics of polycentric governance, institutional flexibility, and the public participation. The Chapter is structured to address the research objectives (see Chapter 4 p81). Hence, section 8.2 presents a brief overview of water management challenges in Greater Tehran regarding the first research objective. Section 8.3 assesses AWM characteristics in the Greater Tehran context in connection with research objectives 2 (the adaptability of the current policies and practices). Section 8.4 addresses objective 3 of the research, which are, the potential advantages, feasibility, and barriers of applying AWM in Greater Tehran. The strengths and weaknesses of the three elements of AWM framework are then discussed, to draw conclusion about the suitability of AWM application in developing countries sited in the Middle East region. This is followed by the research reflections, research limitations, and ideas for further research. The Chapter ends with concluding comments.

8.2. Objective 1: Greater Tehran water challenges

Chapter 6 examined and built the knowledge on the challenges that the water management of Greater Tehran is facing, and investigated how the water

companies were addressing those challenges. The case study in Greater Tehran companies highlighted two main categories of technical and institutional challenges. These challenges are discussed in turn below.

The research findings (Chapter 6) supported the literature discussion in Chapter 3 p62, which despite some institutional reform in 1980s, the water management of Iran is still mainly supply-focused. The vast majority of investments of the water companies were used for addressing technical challenges. As mentioned in Chapter 6 p169, the companies were flexible in a technical/engineering side, and they were trying to invest more in new technologies for upgrading their facilities. Technical challenges were involved with water loss, water supply, and water quality. There was a notable difference in technical water challenges between two companies in Greater Tehran. For instance, SEW Company had an additional problem of subsidence phenomenon, which is caused by the water level drop in the Varamin plain groundwater. This problem is related to the excessive use of the area's groundwater resources. As the city of Varamin has no access to any surface water resources, the company has to supply the city's water by extracting water from the wells. Besides the SEW Company, agricultural and industrial sectors are consuming the groundwater through underground extraction. In addition, the illegal use of groundwater by these sectors is making the situation worse. Regarding the institutional challenges in Greater Tehran, problems highlighted by participants were shaped around financial, managerial, water price, and population increase. The findings (p162) showed that the companies' functions are weakened by the financial problems as a result of inadequate budget. The Greater Tehran water

companies' performance and projects are affected by the financial problems, and therefore many proposals and projects were being held back or rejected regarding the financial problems. Some interviewees had doubts about the appropriateness of the government's new regulation of working with the private sectors. They questioned why the Government gives the money to the other private companies and not their water company, they thought it was not logical and it could lead to corruption. The findings (p164) in the companies indicated that the water price is determined by the government, and the water tariffs were not balanced with the water companies' needs. The findings (section 6.3, p166) highlighted the lack of interaction between the different levels of the management, within the Greater Tehran water companies. Management of the companies were under criticism of middle and lower level of employees, as they believed that internal management was traditional and resistant to changes. Moreover, the management of the companies was criticised by the interviewees for not having enough knowledge in water related issues, and also of being influenced by the political issues. The findings (section 6.3, p167) stated that some of the interviewees believed the changes in the management of their companies were motivated by the political issues, rather than the appointees' knowledge of the water management.

8.3. Objective 2: adaptability of the water policies and practices

The research examined the literature regarding the adaptive management, and how the academics within the water sector define the adaptability. Participation plays a central role in the concept of adaptive management,

which is closely linked to the concept of social learning. Adaptive management concentrates on learning and adapting through partnerships based on finding common ground where managers, scientists, and citizens can try to learn together (Bormann et al 1999, Von Korff et al 2012). The research highlighted the recognition of AWM among the water academics as a possible path for reaching sustainable water management. The concept of AWM provides insights into some of the governance factors in order to support more sustainability (Pahl-Wostl et al 2007, Keath and Brown 2009). As highlighted in Chapter 2 p34, a wide range of approaches could be identified under AWM. These approaches are intended to face the current water problems, as well as the future water uncertainties considering the sustainability. The review of the literature led to the development of an AWM framework for this research. The framework enabled the research to investigate the extent of institutional adaptability, by examining the level of interactions within the institution, with external organisations, and with the water consumers. Accordingly, the three main characteristics of the AWM referred to as polycentric governance, institutional flexibility, and public participation were used as a guidance to assess the institutional capacity for delivering AWM in Greater Tehran water management.

8.3.1. Polycentric governance

As highlighted in Chapter 2 p26, in polycentric governance, the decisions are reached by the involvement and cooperation between different stakeholders. This characteristic could be recognised by the networks of interactions with external organisations. The case study investigated two issues that helped to

understand the water governance in Greater Tehran. These issues consisted of companies' decision making process, and the companies' interactions with external organisations.

First, in the level of decision making process, the information gathered from the companies' websites supported the understanding of companies being registered as private companies with Boards of Directors and the Chief Executive Officers. However, the findings (p138) indicated that companies' budgets mainly come from the government. Also, the companies' Chiefs of Executives are appointed by Ministry of Energy. In fact, the companies, despite being private in name, act as a part of the government. The findings from the interviews in the companies (p141) showed the companies' dependence on the government regulations and budget, and indicated that they cannot take decisions without permission from Ministry of Energy. Accordingly, decision making in the companies needs to follow the guidance set out by Ministry of Energy. The companies only have freedom to interpret governmental regulations in appropriate strategies and practices for dealing with their local circumstances. Moreover, the findings (p141) highlighted that the top managers in the companies believe that the water management should be centralised, and one authority should be responsible for dealing with all the regions. Thus, the TWW Company in Greater Tehran is seeking to take action to take over the remaining small companies in Greater Tehran, in order for there to be one water company for Greater Tehran. As indicated in Chapter 2 p28, the polycentric governance has a notable disadvantage of possible conflicts between different stakeholders. This could put off some of

the managers from moving towards more adaptability, through preference for centralised governance.

Second, at level of companies' interaction with external organisations, the findings (section 5.6.2, p136) showed that the interactions with external organisations are mostly built on the bureaucratic procedures. For example, the companies have routine cooperation with municipality and the organisations of gas and electricity. These official procedures, especially with the municipality, seemed to cause obstacle and delay in the companies' inter communication processes. Considering these issues highlighted that, in terms of the polycentric governance characteristic, neither of the case study companies in Greater Tehran could meet the full AWM requirements and therefore, could not be indicated as adaptive.

8.3.2. Institutional flexibility

As highlighted in Chapter 2 p29, institutional flexibility is concerned with social flexible strategies allowing social feedback, and adjustment between different levels within the institution. For understanding the companies' institutional flexibility, the two issues of companies responses to the water challenges (technical and institutional), and the interactions between different levels within the companies were investigated.

First, the study showed that the main intention of the companies is to overcome the technical problems of the water management in Greater Tehran. The findings (p170) showed that the companies have mostly technical flexibility, and the process within the companies is to mainly address the technical problems (e.g. water leakage control, adopting new

technologies). The findings (section 6.2.1, p147) highlighted that the recent investments in companies were related mostly to the technical challenges of water loss, water supply, water quality, wastewater system, and companies are showing interest to adopt the new technologies. In other words, the companies are flexible mainly on the technical basis, or engineering side of the water management, which is the characteristic of WSM. The findings (Chapter 6) supported the literature in Chapter 3 p67, that the current water management of Iran is dominated by a supply side water management.

Secondly, the research findings (p169) showed that the decision making in the companies is mainly a process carried out amongst the upper managers. As indicated in Chapter 6 p169, the other members of the companies think they are not being heard, and not involved in the companies' decision making because of their lower rank. In terms of institutional flexibility, considering the above discussion of companies' flexibility in the technical challenges, and the lack of interaction between the different levels within the companies, none of the companies can be seen as adaptive.

8.3.3. Public participation

This section highlights how adaptive the companies in Greater Tehran are in relation with the public participation characteristic. AWM encourages the public participation in water management, and sees it as a part of water management. The findings, as indicated in Chapter 7 p176, showed that both companies are considering people as the water receivers, and companies want to provide people with the best related services. Accordingly, in terms of public participation, the findings (pages 141, 171 and 196) suggested that,

water management in Greater Tehran cannot be seen as adaptive. Figure 8.1 summarises the outcomes of the AWM characteristics in Greater Tehran.

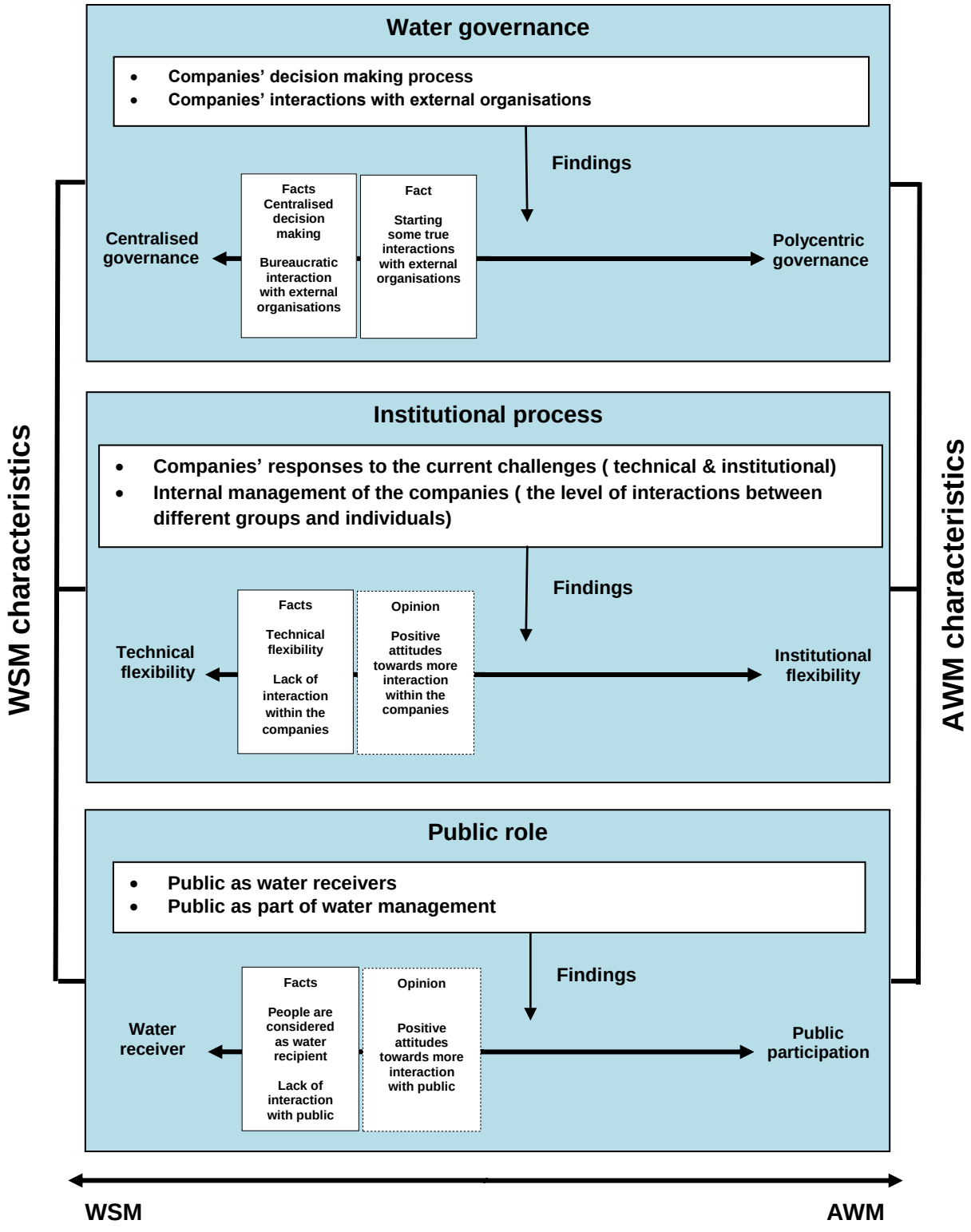

Figure 8.1 Findings of adaptability in Greater Tehran water companies

Overall, assessing the AWM framework suggested that in terms of polycentric governance, institutional flexibility, and the public participation, the water management in Greater Tehran is not adaptive. However, the findings (p170) indicated that there is some desires, and potential in water companies towards implementing adaptive strategies. For example, Chapters 5, 6 and 7 indicated that the professionals are interested towards more interaction, and companies have started practicing more collaborative approaches with other organisations and the public.

8.4. Objective 3: feasibility and barriers using AWM in Greater Tehran

Chapter 2 provided an account of current mainstream water approaches of WSM, WDM, and IWRM. The main criticism regarding WSM and WDM, is that they are not a sustainable path, and the IWRM approach is criticised for being problematic to migrate from theory, to practice (Jeffrey and Gearey 2006). In recent years, AWM came to light as an approach to address the current water problems, as well as future water uncertainty. However, some authors such as Molle (2008) believe that the concepts like AWM are just dreams, he calls these theories nirvana concepts that are expressing what the world should be, when they don't actually have much applicability to what happens in the real world. Bearing this criticism in mind, this section explores the possibility of implementing AWM characteristics in Greater Tehran, and evaluates the applicability of the AWM application on the ground. The findings (Chapters 5, 6 and 7) highlighted that moving towards more adaptability in Greater Tehran water management has limitations and benefits as discussed in turn below.

8.4.1. Polycentric governance

As discussed in Chapter 5 p139, until 1990, the water management of Tehran was carried out by different authorities of municipalities and the regional government. Having different authorities in water management was not a successful experience, as there were disagreements over subjects of the clean water and wastewater discharge (Mahmoudian 2004). This experience in the past led the water management towards a more centralised governance in Greater Tehran. Chapter 5 p129, highlighted that from 1990 onward, the water related activities in each province in Iran is carried out by the Province Water and Wastewater Companies (PWW Co). The initiative for establishing the PWW Co was to allow the private sectors to get involved in the water management. It was assumed that the private sectors should become responsible for production and services, while the Government acts as a monitoring body. Now, even 20 years since the reform was introduced, this study highlighted that, despite of promoting the establishment of the TPWW Co to allow the involvement of the private sector in water management, the implementation of the privatisation did not go down successfully. The study showed that, in fact, TPWW Co is a part of the government. The finding (p166) emphasised that the management of the companies was criticised for being underachieving, and weak by the people working in the companies. The weakness of the management could be rooted in the centralised organisational arrangement, and restriction of the managers' decisions which should be authorised by the Ministry of Energy. As mentioned in Chapter 5 p133, companies are instructed by Government, and therefore the managers are not in full control of the companies. Actually,

the senior managers of the Greater Tehran companies were not happy with the current situation of following their disciplines that the governmental guidelines had set out for them. This is because that makes them weak in decision making, and builds a barrier with the people inside their companies. The findings (p129) highlighted that one of the reasons that companies are following the governmental guidelines is the financial needs. The water companies need the Governmental budget to stay operational.

In the level of decision making, the findings (p141) indicated that there was no interest and/or trend in the organisational body for decision making concerning the polycentric governance. As discussed in Chapter 2 p27, polycentric governance, despite having transparency in decision making by engaging different stakeholders, have a disadvantage of risk of conflicts between diverted organisations involved in decision making. Considering this disadvantage, some managers prefer the centralised governance over the polycentric governance, to prevent the risk of the conflicts (Williams and Brown 2012). As mentioned in Chapter 5 p139, Tehran water management experienced some conflicts between different authorities in the decision making process in the past. Accordingly, the Greater Tehran water managers believe that the centralised management with one authority works better in the region. In fact, water governance in Greater Tehran is moving towards being more centralised by intending to take over the remaining small private water companies.

In level of interaction with external organisations, the study highlighted that, despite companies' bureaucratic cooperation with the other related organisations, they have recently undertook the true interaction with some

organisations. This could help to take more inclusive decisions with mutual interests. The findings (p137) highlighted the changing attitude towards the cooperation with different organisations. For example, in the recent years, the companies have started showing some interactive cooperation with the environment and standard offices. In this cooperation, the companies are working closely with those external stakeholders and organisations, considering the teamwork through an information exchanging network. For example, some of the companies' projects depend on the environmental organisation's approval, for assessment of the companies' project to comply with the environmental regulations.

In brief, the implementation of polycentric governance is limited by the current established centralised governance in Greater Tehran. The findings (p141) highlighted that, sharing and having various authorities in decision making do not have a place in the current water management of Greater Tehran. The water management of Greater Tehran wants to be responsible for the whole district as the centralised water governance. Another barrier in applying polycentric governance, is the official and bureaucratic interactions with other organisations. However, the water management in Greater Tehran showed its interest in having collaboration, and coordination with some related external organisations based on true interaction. Accordingly, the polycentric governance could be promoted in Greater Tehran on the aspect of interaction with external organisations.

8.4.2. Institutional flexibility

At the level of institutional flexibility, the companies showed mostly technical flexibility. Over the last decades water management in Iran has experienced different water paths. From the local based with community involvement, to the current national centralised management where people are not involved in water management. During this time, the urban population increase, and the people's life style change pushed water managers towards more water supplies, and the result was the domination of the supply oriented management. Since the introduction of WSM in Iran, construction of big dams started, and the qanats were replaced by deep, and semi-deep wells (Ardakanian 2005). Building dams and extracting water from groundwater were supposed to flourish the region. However, now, things changed, more water is needed while the uncertainty of the water is apparent. The water resources are shrinking all around the country. In fact, Iran is running out of the situation for more WSM. As highlighted in Chapter 3 p67, Tehran as the largest and most populated city of Iran, has great challenges related to the technical side of water management such as limited available water resources, increase in demand and waste production, and high loss of urban water. The available water is decreasing rapidly; in the near future the water availability in Greater Tehran will be only 100 m^3/capita/year (Mokhtari 2013). As indicated in Chapter 3 p60, encouraging the farmers to pump up groundwater was part of the modernisation of the water management in Iran. At the time, the authorities tried to discourage the use of qanats by exaggerating the disadvantages of the qanats (Balali et al 2009). Chapter 3 p75, highlighted that in the past, the Greater Tehran water supply was

provided by the regional qanats. Yet they are being forgotten, and now the remaining of them are causing problems. However, as indicated by Balali et al (2009), with the growing risk of the water scarcity in Iran, there is an interest in the rehabilitation of the qanat underground irrigation system, and its integration with modern water supply systems. They indicated such rehabilitation can lead to a significant drop in the reliance on deep wells. As highlighted in Chapter 3 p76, qanats are compatible to the Middle East region. According to Rahnemaei et al (2013), qanats could be considered as an alternative water supply, and the sooner water managers realize the merits of qanats, the better. As discussed in Chapter 2 p38, SUWM approach works in harmony with nature, and tries to minimise the impact of urbanisation on the natural water cycle by innovative practices such as managing the storm-water and drainage or water collection (Hoyer and Dickhaut 2010, Lloyd 2001). Thus, recognition, repairing, and putting in operation of qanats as an AWM practical approach could help the current water situation, as well as the future of the water in Greater Tehran. The technique of qanat has harmony with the Middle East region situation, for example transfers water with the use of the force of gravity and uses underground to prevent water evaporation. Using qanats for agricultural proposes for cities with limited water resources, such as Varamin, could encourage the farmers and industries to use less deep wells. In the long term, this could help save the areas' groundwater, because, as mentioned in Chapter 3 p58, water in the qanats comes from upper lands far from the area using gravity. However, the findings in Chapter 6 p157 highlighted that there is no organisational responsibility for maintaining qanats in Greater Tehran,

and for the time being, water companies have no interest, and no authority to sustain them.

In level of the internal management of the companies, the findings (section 6.3, p166) highlighted the lack of interaction between the different levels and groups in the companies. The institutional flexibility according to the AWM is established more on human interactions, and depends on the process of the social feedback and adjustment, regarding the individuals and groups within the institution (Pahl-Wostl et al 2007). As discussed in Chapter 2 p30, the institutional flexibility is associated with enabling more interactions in all levels within the institution, and frequently questioning the current status of the institution. As mentioned earlier in this Chapter, the institutional flexibility in Greater Tehran is undermined by the lack of interactions within the companies. This lack of interaction is related to the companies centralised water governance, which encourages the decision making process to be carried out in the upper levels of the companies. The other members of the companies believe that they are not being heard because they are in the lower rank. The findings (p169) showed that these employees want to get involved in the companies' decision making.

In brief, the implementation of institutional flexibility is limited by the technical water challenges, and the lack of interaction within the companies of Greater Tehran. The findings (p162) indicated that the institutional challenges have an effect on the technical challenges. The addressing of the technical challenges in Greater Tehran is limited. This is due to the institutional challenges. For example, some of the technical projects are stopped, or being delayed regarding the financial restriction. Accordingly, applying AWM

that promotes the institutional development could help tackle the technical challenges. Chapter 6 p170 highlighted a positive attitude towards taking more interactions among the water professionals. For example, some interviewees believed that more interactions between different levels of people within the companies are needed alongside the technical issues. Supporting the institutional development within the companies could be beneficial for the companies to overcome their problems more efficiently. The encouragement of more interaction in the companies, by involving individuals and groups in decision making process could help the companies to have better evaluation of their policies and practices. As discussed in Chapter 2 p35, Soft Path as an adaptive approach relies on human ability to solve water problems. It encourages managers to expand their focus beyond traditional technologies by changing practices and behaviour to reach their goals (Brooks and Brandes 2011, Brandes and Brooks 2007, Wolff and Gleick 2002). Accordingly, adaptability could be promoted in Greater Tehran by investments in conducting more interaction and social learning within the companies. One of the most useful changes that could be put in practice is encouraging people to have more interaction in water companies. For example, promoting regular meetings between people from different offices within the companies. This could develop individuals/groups' understanding regarding companies' current situation from different aspects. However, it seems that this issue is not the current concern of the companies' top managers.

8.4.3. Public participation

The public participation is limited by the companies' perspective on the people's role in water management. However, there are positive attitudes towards adaptive strategies. In the companies, there is some interest in involving people in water management by giving the public information regarding the water conservation. The findings (p176) showed that more interaction with the public could solve some of the Greater Tehran water problems. For example, collaboration with public (children in the nurseries and the housewives), could help the water management in the aspects of water loss and consumption management.

At the level of interaction with public, examining the public views on their role in water management highlighted five factors that are affecting public participation in water management. Considering these factors by the water companies would help them to move towards more adaptive strategies, and making more effective decisions. These factors, as highlighted in Chapter 7 p178, are received information, water price, personal practices and values, the degree of trust towards water authorities, and involvement in water management. The findings (p193) highlighted that there is a high potential in the people's side to interact with the water companies. The findings (p193) showed the positive attitudes of people towards taking part in their cities' water management. People showed their concern about their cities' water issues by expressing their views on the water related issues, and telling their problems. They were ready to give their suggestions for better water use in their cities. It appears that people expect to receive more information from

the water companies. However, the findings (p178) showed that people do not feel they are getting enough and right information.

Setting price is one of the recent strategies in Greater Tehran companies as a part of broader strategy in the whole country. As indicated in Chapter 7 p184, the implementation of this policy regarding the cutting of the water subsidy started since 2010, which resulting in increased water price. During the past three years, the water price gradually has been increased, and a higher water price increase is underway. The aim of this policy was to recover the water supply/production, as well as making water consumers save water. The findings (p184) regarding the public opinions highlighted that the implemented water policy of water price setting could make people change their water behaviour, but not necessarily for the long term, after a while most of the people return their previous routine. Considering this issue is questioning the recent water increase policy for covering the water cost production. The findings (p184) regarding the water price highlighted its close relation with the social/cultural issues. As indicated in Chapter 4 p103, the case study in Greater Tehran considered people from a different socioeconomic status. The findings (p186) showed that people from the deprived areas have different reactions to the same water policies implemented by the water companies. The findings (p185) showed that most people in city of Tehran did not change their water use habits following the price increase, especially in the north of Tehran where people are wealthier than other parts of Greater Tehran. In contrast, in the deprived area with working class people (city of Varamin), water consumers were more concerned about the water price. This suggests that those with lower socio-

economic background are more affected by the water price increase, and they feel they have to change their water use behaviour. Considering this point, the fairness on the poor people is a question. Moreover, the findings (p165) highlighted that the company in the deprived area had difficulties getting the water charges from the water consumers. A large majority of water consumers of the company were ignoring their water bills, leaving big outstanding debts. Furthermore, the findings (p151) showed that the apparent water loss (illegal piping), in the poor area had created a great trouble for the company. Confronting this problem seemed to be very difficult for the management due to the current social/cultural considerations leading to losing money.

The findings described in Chapter 7 p192 showed that there is a lack of trust among the public in water authorities. People think they are not given the right information about appropriate water supply/consumption in their cities. As mentioned in Chapter 3 p66, one of the essential actions in the national water management programs is the adoption and implementation of general plans for recycling water nationwide. The findings (p193) of this research highlighted the public's negative reactions towards the recycled water. People are not sure whether the water companies could treat and refine the water properly, and because of that they do not like to use recycled water. This negative reaction towards recycled water could be also related to the lack of information between the companies and the water consumers. This distrust could have an effect on some of the strategies of the water companies in the future. These social/cultural challenges show the importance of the social/cultural factor in institutional development in the

Greater Tehran water companies. The companies need to understand their own public. To reach a sustainable water management and water efficiency, it is necessary for decision makers to identify specific culture and behaviours of the people in the society and consider their relationship with water companies (PRSA 1982, Tajrishy and Abrishamchi 2005).

In brief, the characteristic of the public participation could be promoted in the Greater Tehran water management. Despite that, companies see the public as water recipients. There is potential in the companies towards using more adaptive strategies to interact with people. Considering the public perspective indicated that despite people's mistrust in water authorities, they want to get involved in water management. The lack of information, communication, and trust are affecting the water consumers' behaviour regarding the water policies. The investment in institutional development in Greater Tehran water companies, by increasing more knowledge and understanding of the public attitudes towards water, could create immense benefits for the water management to overcome water challenges in a sustainable manner.

The above discussion indicated that there are potential advantages, feasibility, and barriers regarding AWM in Greater Tehran. The barriers for applying the AWM strategies in Greater Tehran are established centralised governance, bureaucratic interaction with external organisations, technical flexibility, lack of interaction within institution, and seeing the public as water receivers. However, the findings (Chapters 5, 6 and 7) highlighted that there is the possibility of promoting the AWM characteristics in Greater Tehran. Despite the centralised decision making process, the water governance of Greater Tehran shows interest in being adaptive by conducting more true

interaction with external organisations. Moreover, the discussion showed that there is a potential within the companies towards more adaptability by more interactions within their institutions, and the also with the public.

8.5. Objective 4: AWM application suitability in Middle East region

As indicated by Figueres (2005), water management in developing countries suffers from the common water problems, such as ageing infrastructure and high water losses in the distribution system. Khatri and Vairavamoorthy (2007) highlighted that historically in developing countries the performance of urban water systems remains below expectation. The findings (Chapter 6) of this research supported the statement above, that the developing countries such as Iran have a lot of technical challenges, and addressing the technical challenges are first in the line. Here, the question is whether it is realistic to introduce AWM when the WSM has not been fully progressed in developing countries. As mentioned earlier in this Chapter, addressing technical challenges in developing countries are limited by the institutional challenges. For example, socioeconomic issues could cause more technical challenges in relation to the water loss (Chapters 6 and 7). Actually, the findings (Chapter 6) of this study showed that applying AWM could help prevent and address some of the technical challenges by improving institutional performances.

As highlighted in Chapter 3 p48, some of the authors believe that developing countries' water system failing is related to their institutional weakness. Khatri and Vairavamoorthy (2007) indicated that the failing of systems, particularly in developing countries, has been partly the result of a top-down approach

with limited involvement of stakeholders. They indicated that the weakness of the water management is related to the unsuitable institutional set-up, and the lack of understanding of the institutional background in which the urban water system is managed and operated (Khatri and Vairavamoorthy 2007). Chapter 3 p49 highlighted that some of the Middle East region countries are investing in non-traditional infrastructure to overcome their water problems such as water scarcity. However, these investments are often not making optimal economic returns because of the lack of the necessary institutional changes (World Bank 2013). It is indicated that Middle East countries need improve their institutional structure by more coordination with other organisations and civil society (World Bank 2013). In fact, the AWM application offers a better understanding of the institutional arrangements, and helps to promote more human interactions inside, and outside of institutions. Accordingly, different parts of water sectors could get involved in water management. The findings (Chapters 5, 6 and 7) of this research indicated that by applying AWM application, developing countries could promote their technical and institutional performances simultaneously. The research findings (Chapter 6) highlighted that investment in the institutional challenges improves the institutional performance, and also helps to confront the technical challenges in more efficient and sustainable respects. In particular, considering the similarities of geographical situation and social structure similarities, promoting AWM in Middle East countries should be done now not later.

8.6. Reflections on the research

This section reflects on research and personal learning that was gained during this research. Highlighting some issues regarding the research process could be beneficial for the future researcher to put forward their practices.

Methodology

A qualitative research was chosen for this study due to the nature of the study, as discussed in Chapter 4 p82. The research used the primary data collection method of the data collection water by interviewing people in person. A semi-structured interview was chosen for the study allowed to uncover the issues that were unknown to the researcher. For example, people's opinion regarding the water price or water quality or professionals' opinions regarding the managerial issues in the companies. I believe that I was successful in selecting and characterising the interview questions according to the research framework of AWM. This led the interviews to be focused on the topics of the questions. The interviews were face to face from ½ hour to 1 ½ hour, which was a fair time to think and answer the questions. During the case study two groups of data were collected. The first group related to the water professionals. The data gathered from senior managers, middle managers and the experts from the TWW and SEW companies in Greater Tehran. These two companies were provided a suitable setting for study to investigate the water management in Greater Tehran upon the size, covered area, and the specific challenges. Given the consideration of the study, I am happy that this sampling frame allowed me to study some of

variety of water elements in Greater Tehran. I found learning more about the water governance with going inside the companies and talking to people. Having permission from the head of the companies made my contact to the people inside the companies easy, and I had no problem in arranging the interviews during the working hours of the companies.

The second group of data in the case study was related to the water consumers in the case study, who were covered by the TWW and SEW companies. The samples were taken from the north and south of the city of Tehran, and the city of Varamin. These particular groups of the population allowed the researcher to investigate different socioeconomic status in the case study. For example, the findings (p185) showed that the areas with lower socio-economic background are more affected by the water price increase. Regarding the public interviews, I learned more about water sanitation in Greater Tehran. The interview processing with public allowed the researcher to see the water companies challenges (e.g. water price) in a different dimension. Surprisingly, people were so interested to have their say regarding their water problems and their suggestions.

Research conceptual framework

To investigate the adaptability in the case studies, the research developed a framework of AWM to start from. The framework is built upon three characteristics of polycentric governance, institutional flexibility, and the public participation. This application is needed to be tested first, and find out whether it is a suitable framework to investigate and analyse the adaptability in the water institutional structures. The framework required that the

researcher took a look at the water problems in Greater Tehran with respect to the social and institutional aspects. A conceptual model of AWM (Figure 4.3 p90) was proposed to analyse the data collected through the case study. It was important to find out whether the concept of Adaptive Water Management is a suitable application for Greater Tehran. The conceptual model was established based on three characteristics of AWM as the indicators of adaptability in the water institutions.

Personal reflections

This section reflects on the personal learning and the experiences that I have achieved during this study. Fortunately I had enough time to study the related fields and gaining the knowledge before starting my interviews. My interviews took place in Tehran and Varamin, and I had to travel to Iran to process the interviews. As an independent self-funding researcher, I found the importance of financial matter during my fieldwork. During my stay in Tehran, I experienced of the uncertainty whether my interviews with water professionals could start. Actually, I was lucky to have found a powerful connection to introduce me to the water company in Tehran that made my job so much easier than I thought. I started to go to the TWW Company and spoke to the water professionals in the productivity department. I had arranged each one of the interviews in a friendly way. I was introduced to the SEW Company in Varamin by the head of productivity department of TWW Company. I had conducted the interviews with the water consumers of the TWW and SEW in mosques, markets and houses with arrangements. All of interviews were face to face, and I had no problem with the participants

(professional and public) as I have experiences of working and communicating with people in Iran. Each one of the interviews was interesting for me because they were increasing my knowledge about the water management and water challenges in Tehran. Having interviews with two water companies in two different cities helped me to understand the social/cultural, environment, and economic values related to the water management. Before starting my research, I was thinking of water management as a more technical management. In fact, I never expected to gain such an experience in my research that how much the water management could be complicated in the social/cultural aspect.

One of the difficulties that I had anticipated was data collection in Varamin. Despite being from Tehran, the city of Varamin was unfamiliar for me. However, after starting my data collection I found the people, and also the water company of the city much friendlier than Tehran. Another difficulty in my research process was spending a lot of time translating the data collected from Persian to English. Most of the data was audio recorded that made the process of translating even longer.

8.7. Limitations and further research

This research has used a conceptual approach of AWM as a pathway to more sustainability in water management. The study highlighted the need for research on current mainstream water on adaptability, to the current and future changes. This research provided lessons for conducting further research in adaptability. Thus, some suggestions for further research are highlighted in this section.

- One limitation of these findings was the fact that the AWM characteristics were explored only within two water companies in Greater Tehran. However, examining water consumers alongside the water companies was an advantage to this study. Although, the focus on water companies and water consumers provided a partial understanding of water management of Greater Tehran. Water related organisations and the Ministry of Energy are the other parties are also involved the Greater Tehran water management. I regret that I was not able to investigate these aspects due to limitation of finance and time. It would be valuable to include them in any further research.

- This thesis suggested the benefits of promoting AWM in institutions by more investments in institutional challenges and more communication within and with external organisations. However, further research is needed to qualify the feasibility and effectiveness of the AWM framework.

- In this thesis, the case study highlighted the various institutional and social factors involved in water management. Trying to investigate more on these issues, and how water companies and the public could work closely would be beneficial, and could provide more information on the pathway towards more adaptability in water management.

- The findings of the study suggest that applying the concept of AWM could have a significant influence in a Middle East urban context. Further

research is needed to validate the AWM application in various contexts in developing and also developed countries.

- Research on the AWM in the Middle East is still in the first stage. There is a need for more research in AWM in the region. Using the similar studies within the culturally close countries would be beneficial for comparison. A re-examination of this study in other developing countries, particularly from the Middle East countries, would increase the validation of the results.

- Investigating the practical adaptive approaches and how they could be promoted in the institutional structure could be considered in the further researches.

8.8. Concluding comments

> *"Water management, by definition, is conflict management. Water, unlike other scarce, consumable resources, is used to fuel all facets of society, from biologies to economies to aesthetics to spiritual practice...there is no such thing as managing water for a single purpose all water management is multi-objective and based on navigating competing interests"* (Wolf 2008 p51).

This thesis argued that the current water management approaches need to change their course for more sustainable water strategies. Over the last decades, academics in the water management have highlighted that the

AWM could be an application to deal with current and future uncertainties through a sustainable pathway. Contributing to a better understanding of the water institutional structure involving AWM within the context of Greater Tehran water companies has been a key element of this thesis. The study used this understanding to develop strategies that can be used within the water companies to investigate AWM application. The research highlighted that the AWM application could be promoted by more participation in various levels of institutional structure. The companies could have improved their performance by more social learning within their institutions and also with the public. More participation and interaction could create greater benefits for the institutions' performances regarding technical and institutional challenges.

AWM implementation would be an important step in water management towards more sustainability in the Greater Tehran. Thus, AWM could be promoted in Iran to improve the institutional performances that could help the water management to address its challenges in a sustainable way, and prepare them for the future uncertainties.

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Appendix A

Please select the appropriate answer or explain in a short sentence

Interview no. …… Interview date…….

Location of the organisation…… Name of the organisation……

1. What is the main purpose of your organisation?

2. What is your position and main role in this organisation? And how long you have been working in this organisation?

3. Your organisation is:

a. a government company b. a private company c. a part of government company

4. Can you indicate roughly the proportion of water in your district which is obtained from?

   a. Underground water
   b. Surface water

5. Is there any area in your district with no access to piped water?

If yes could you please indicated how these areas get the water?

   a. Wells, fountains, aqueducts
   b. Water tank
   c. Packaged water (bottled, gallons, etc.)
   d. River, pond, stream, rain water
   e. Other (please name)

6. Is your organisation responsible for water sale in areas stated above? Otherwise do you know what organisation is responsible?

7. Is there any difference between the price of piped water and the other potable water? How?

8. Piped water in your district is used for:

   a. domestic consumption
   b. urban agricultural
   c. parks and green spaces
   d. Industrial

9. In your opinion the water price compared with the production cost is:

a. Low b. Fair c. High

Interview questions (Water professionals)

Part 2

Interview no. ……..… Interview date…….

Location of the organisation……... Name of the organisation……

Starting time …… Finishing time ……..….

1. What do you see as the main risk or threat which Tehran's water system is facing? Can you explain what your company is doing to address this threat?
2. If you had extra financial resources to invest in Tehran's water management, what would you see as the priority areas for investment?
3. I would like to understand more about decision making in your organisation. Can you pick an example of an initiative or investment which has been made recently that you can tell me about?
    a. What is the initiative or investment?
    b. Who took the decision to undertake this initiative / investment?
    c. How did the initiative / investment relate to the central government's policies and perspectives? Did someone in Government know about it – or is it something that the company can just go ahead and do by itself?
    d. Who in the company contributed to the decision?
    e. Did the decision involve interaction with other organisations – if so, which, and what form did the interaction take? How did the initiative change as a consequence?
    f. Did the initiative involve interaction with your customers? If yes, what form did this interaction take? How did the initiative change as a consequence?
4. Is there anything else you would like to tell me about water management in Tehran?
5. If I wanted to obtain more information would it be possible to come back and to interview you again?

Appendix A1

کارشناسان آب قسمت۱

شماره مصاحبه ..... تاریخ مصاحبه .....
نام و محل سازمان .....

۱- نقش اصلی و موقعیت شما در سازمان آب چیست یا چه بوده است ؟

۲- چند سال سابقه ی کار درسازمان آب راداشته یا دارید ؟

۳ - سازمان شما:
الف. یک شرکت خصوصی است
ب . قسمتی ازیک شرکت دولتی است

۴- به طور تقریبی در صد آب مورد استفاده در منطقه تان از منابع ذیل چه مقدار است؟
الف. آبهای زیرزمینی
ب. آبهای سطحی

۵- ایا در حوزه تحت پوشش شما مناطقی هستند که به آب لوله کشی دسترسی نداشته باشند ؟
اگر چنین مناطقی وجود دارند ، چگونه آب خود را تأمین میکنند؟
الف. از طریق مخازن آب
ب. از طریق لوله های آب عمومی
ج: از طریق خرید آب از تانکر های ویژه
د: چاه های زیر زمینی
ه : از طریق آب بطری شده
آیا روشی به جز موارد بالا نیز هست ؟ لطفا توضیح دهید

۶- آیا مسولیت فروش آب در چنین مناطقی به عهده ی شرکت آب و فاضلاب تهران است ؟
اگرنه آیا میدانید چه سازمانی چنین مسولیتی ر ا بر عهده دارد ؟

۷- آیا تفاوتی بین قیمت آب آشامیدنی لوله کشی و سایرآب های آشامیدنی وجود دارد؟ چگونه؟

۸- آب آشامیدنی لوله کشی درمنطقه شما برای چه مواردی استفاده می شود:
الف. مصارف خانگی
ب. کشاورزی
ج. خدمات پارک ها و فضای سبز
د. صنعتی
ه. سایر خدمات (همانند گرمابه های عمومی،فعا لیتهای ورزشی و...)

۹- به نظر شما آیا قیمت آبی که در اختیار مشترکین قرار می گیرد درمقایسه با قیمت تمام شده آب:
الف. کمتر است
ب. منصفانه است
ج. زیادتر است

کارشناسان آب قسمت ۲

شماره مصاحبه ..... تاریخ مصاحبه .....
محل سازمان ..... نام سازمان .....
زمان شروع مصاحبه ..... زمان اتمام مصاحبه .....

۱- مهمترین چالش سیستم آب شهر تهران را چه چیزی می بینید؟ آیا می توانید توضیح دهید که در شرکت شما چه اقداماتی برای مقابله با این چالش انجام شده است ؟

۲- اگر شما منابع مالی اضافی برای سرمایه گذاری در مدیریت آب شرب تهران دراختیار داشتید، الویتهای سرمایه گذاری را در چه زمینه هایی در نظر می گرفتید؟

۳- آیا می توانید نمونه ای ازابتکار و یا سرمایه گذاری که به تازگی در سازمان انجام شده است را انتخاب کرده و بگویید؟

الف. این ابتکار یا سرمایه گذاری چه بوده؟

ب. تصمیم گیری برای انجام این ابتکار و یا سرمایه گذاری چگونه و با چه کسی بوده؟

ج. چگونه این ابتکار یا سرمایه گذاری به سیاستها و دیدگاههای دولت درمورد مدیریت آب مربوط می شود؟ آیااین ابتکار / سرمایه گذاری با اطلاع وزارت نیرو انجام گرفت یا می توانست به تنهایی به وسیله شرکت شما پیش برود؟

د. چه کسی در سازمان شما به تصمیم گیری در این مورد کمک کرد؟

ه. آیا این تصمیم شامل تعامل با دیگر سازمان ها بود؟ اگر چنین است این تعامل با دیگر سازمان ها چگونه انجام گرفت؟ وچه اثری بر نتیجه کارداشت؟

و. آیا این ابتکار شامل تعامل با مشتریان آب نیزبود؟ اگر بله، این تعامل با مشتریان چگونه بود و چه اثری بر نتیجه کار داشت؟

۴- آیا مورد دیگری درباره مدیریت آب در تهران وجود دارد که مایلید متذکر شوید؟

۵- آیا برای تکمیل کردن تحقیقات حاضر به مصاحبه دوباره هستید؟

Appendix B

Interview no. …..... Interview date…… Municipality area…… Water related Company…

Please tick the appropriate box or answer in a short sentence

1	**What age group are you in?**	**up to 20**
		21-30
		31-40
		41-50
		51-60
		60+
2	**Your gender?**	**Male**
		Female
3	**Your qualification?**	**None**
		Under diploma
		Diploma
		First degree
		Master
		Doctorate
4	**The area of the property that you live?**	**Less than 50 m^2**
		Between 50 and 80 m^2
		Between 80 and 100 m^2
		Over 100 m^2
5	**The number of people living in your home?**	
6	**Where you get your water from?**	**Network system**
		Tank
		Other
If other please identify		
7	**The reason of using this water system (or these water systems)**	**Simplicity**
		Suitable
		Low cost
		Conventional
		No other system
		Other
8	**Have you ever had water rationing?**	**Yes**
		No
		I do not know
If yes, when and why was it?		
9	**Are you satisfied with the water quality (taste, colour, and odour)?**	**Yes**
		No
		Unsure
If not satisfied with the water quality name of the most important reason		
10	**Do you ever buy bottled water?**	**Yes**
		No
If yes could you please indicate for what reason		
11	**Part of your city tap water comes from ground water**	**Yes**
		No
		I do not know
12	**What do you think about the current water tariff**	**High**
		Fair
		Low
13	**The current water prices made you to use**	**More water**
		Less water
		No change in water use

You've answered the first part of the research questions do you wish to consider taking part in an additional interview?	Yes
	No

Thank you for your time and kind cooperation

Interview questions (Water consumers) Part II

Interview no. …… Interview date…….

Municipality area…… Water related Company……

1. What are the main ways of using water in your home?
2. Did you ever try to minimize your water use? How and why would you do that?
3. Have you ever used any water saving devices (such as a low flow kitchen water tap device*) in your house? If no would you like to use them? Why/why not?
4. There is waste water in each house; do you have any idea for reusing the waste water in your house? If it were possible; would you consider practicing your idea?
5. What is your opinion about using recycled water**? If it was available would you consider using it? Why / why not?
6. Did you receive any information about the way they manage water from your water company? If yes could you tell me what was it and what you learnt from it?? Was the information just right / too much / too little for you?
7. Have you ever noticed any public information program in media or received any education from authorities on water? If yes what did they say? If yes, how has seeing/receiving it affected you?
8. If you had the opportunity to make a suggestion to your water company, what would it be? How you would do that?
9. What is your opinion on water price? Did the water price increase change your way of water use? Why/why not?
10. Is there anything that you want to mention in relation to the water management of Tehran?
11. If I wanted to obtain more information would it be possible to come back and to interview you again?

**A low flow kitchen tap is a popular water saving device in Iran*

***Recycled water is reusable wastewater which been treated to remove solids and certain impurities.*

Appendix B1

مصرف کنندگان آب قسمت ۱

شماره مصاحبه ..... تاریخ مصاحبه..... شرکت آب مربوطه ..... شهرداری منطقه .....

لطفا پاسخ مناسب را علامت زده و یا در یک جمله کوتاه پاسخ دهید

۱	گروه سنی شما چیست؟	زیر ۲۰
		۲۱-۳۰
		۳۱-۴۰
		۴۱-۵۰
		۵۱-۶۰
		بالای ۶۰
۲	جنسیت شما؟	زن
		مرد
۳	مدرک تحصیلی شما؟	زیر دیپلم
		دیپلم
		فوق دیپلم
		لیسانس
		فوق لیسانس و دکتری
۴	مساحت ملکی که شما درآن زندگی می کنید؟	کمتر از ۵۰ متر مربع
		بین ۵۰-۸۰ متر مربع
		بین ۸۰-۱۰۰ متر مربع
		بیش از ۱۰۰ متر مربع
۵	تعداد افراد ساکن در منزل شما ؟	
۶	آب مصرفی شما چگونه تأمین می شود؟	سیستم لوله کشی آب
		مخزن
		چاه
		هیچ کدام
اگر هیچ کدام می توانید بگویید آب مصرفی خود را چگونه تأمین می کنید؟		
۷	دلیل استفاده از این سیستم آب چیست؟	متعارف
		دردسترس بودن
		هزینه کم
		هیچ کدام
اگر هیچ کدام می توانید دلیل استفاده از این سیستم آب را ذکر کنید؟		
۸	آیا شما تا به حال سهمیه بند ی آب داشته اید؟	بله
		نخیر
		نمی دانم
اگر بله، چه موقع و به چه دلیل بوده است؟		
۹	آیا شما از کیفیت آب (طعم، رنگ و بو) راضی هستید؟	بله
		نخیر
		در این مورد مطمئن نیستم
اگر نه می توانید بگویید چرا ؟		
۱۰	آیا شما تا به حال آب بطری شده خریده اید؟	بله
		نخیر
اگر بله آیا می توانید بگویید به چه علت آب را خریداری کرده اید؟		
۱۱	بخشی از آب آشامیدنی شهر از آب زیر زمینی تامین میشود	بله
		نخیر
		نمی دانم
۱۲	نظر شما در مورد تعرفه کنونی آب چیست؟	کم است
		منصفانه است
		زیاد است
۱۳	قیمت کنونی آب باعث شده تا شما	آب بیشتری مصرف کنید
		آب کمتری مصرف کنید
		هیچ تغییر در مصرف آب شما ایجاد نکرده است

* شما به قسمت اول این تحقیق پاسخ داده اید. آیا مایل هستید که در قسمت دوم که شامل مصاحبه با پژوهشگراین تحقیق می باشد شرکت کنید؟	بله
	خیر

با تشکر از شما برای وقت و همکاریتان

مصرف کنندگان آب قسمت ۲

شماره مصاحبه ..... تاریخ مصاحبه .....
شرکت آب مربوطه ..... شهرداری منطقه .....

۱- موارد اصلی استفاده آب در منزل شما چیست ؟

۲- آیا شما تا کنون سعی کرده اید که مصرف آب خود را کم کنید؟ چگونه و چرا این کاررا انجام میدهید؟

۳- آیا تا به حال از وسائل صرفه جویی درمصرف آب در منزلتان استفاده کرده اید؟ (مثلا سر دوش شیر آشپزخانه*) اگرتا به حال از چنین وسایلی استفاده نکرده اید ، آیا مایل به استفاده از آنها استفاده هستید؟ چرا بله؟ چرا نه ؟

۴- ضایعات آب مصرفی درهر خانه ای وجود دارد، آیا شما ایده ای برای استفاده مجدد از ضایعات آب در منزل خود دارید؟ اگر ممکن باشد آیا حاضرید که ایده خود را درعمل امتحان کنید؟

۵- نظر شما در مورد استفاده از آب بازیافتی**(تصفیه فاضلاب)دربعضی مصارف چیست؟ اگر در دسترس باشد آیا استفاده از آن را در نظر خواهید گرفت؟ چرا بله؟ چرا نه ؟

۶- آیا تا به حال هیچ اطلاعاتی در مورد راههایی که مصرف آب مدیریت می شود از شرکت آب خود دریافت کرده اید؟ اگر بله می توانید بگویید که چه بوده و شما از آن چه آموخته اید؟ اطلاعات برای شما چگونه بود؟ کافی / بیش از حد / خیلی کم
۷- آیا شما تا به حال متوجه برنامه های اطلاع رسانی مصرف در رسانه ها و یا هر گونه آموزش از طرف مقامات در رابطه با آب شده اید؟ اگر بله، چه چیزهایی را عنوان می کردند؟ چگونه دیدن / دریافت این اطلاعات شما را تحت تاثیر قرار داد؟
۸- اگر شما فرصت این را داشتید که پیشنهادی به شرکت آ ب بدهید؛ این پیشنهاد چه میتوانست باشد؟ چگونه آن راانجام میدادید؟

۹- نظر شما در مورد قیمت آب چیست؟ آیا افزایش قیمت آب تغییری در مصرف آب شما ایجاد کرده است؟ میتوانید بگوئید چرا و چگونه؟

۱۰- آیا مورد دیگری درباره مدیریت آب شرب در تهران وجود دارد که مایلید متذکر شوید ؟

۱۱- آیا برای تکمیل کردن تحقیقات حاضر به مصاحبه دوباره هستید؟

*سر دوش شیر آشپزخانه یک وسیله رایج صرفه جویی در مصرف آب در ایران می باشد.
**آب بازیافت شده ضایعات آب مصرفی است که تصفیه شده و قابل استفاده مجدد است.

Appendix C

Informed Consent Form for water professionals

This Informed Consent Form is for water professional working in Tehran province who we are inviting to participate in our research subject of Adaptive Water Management.

Name of Investigator: Farideh Delavari Edalat

This Informed Consent Form has two parts:

- **Information Sheet**
- **Consent Form**

You will be given a copy of the full Informed Consent Form

Part I: Information Sheet

Introduction
I am a PhD student and I am doing research on the water management in Tehran. I am going to give you information and invite you to be part of this research. You do not have to decide today whether or not you will participate in the research. Before you decide, it is important for you to understand why the research is being done and what it will involve. Please read the following. You can talk to anyone you feel comfortable with about the research. Ask me if there is anything that is not clear or if you would like more information. Take your time to decide whether or not you wish to take part in this study.

Purpose of the research
With continued water resource shortages and population growth rate especially in the big cities along with climate change and its effect on the water resources there will be more unpredictable behaviour in water sectors. Water problems are very complex and they involve different values including social, economic and environmental interests. The purpose of this study is to learn how people in Tehran manage, use and value water. The study wants to know more about water policies because this knowledge may be able to help us for a better water management.

Why have I been chosen?
You are being invited to take part in this research because we feel that your experience as a water professional can contribute to our understanding and knowledge of Tehran water management.

Do I have to take part?
It is up to you to decide whether or not to take part. The choice that you make will have no bearing on your job or on any work-related evaluations or reports. You may change your mind later and stop participating even if you agreed earlier without giving a reason.

What will happen to me if I take part?
What will happen to me if I take part? If you decide to take part, you will participate in an interview with myself. This will take around 1 to 1 ½ hour. During the interview, I will sit down with you in a comfortable place in your work place or in some other place. If you do not wish to answer any of the questions during the interview, you may say so and the interviewer will move on to the next question. No one else but the interviewer will be present unless you would like someone else to be there. The information recorded is confidential, and no one else will access to the information documented during your interview. The interview will be audio-recorded but if

you feel uncomfortable about using the recorder, taking notes will be used. No-one will be identified by name on the audio- recorder or the notes. All data collected during the interview (notes, audio recording) will be kept anonymous. Your name and the name of your company will remain anonymous. You will not be identified by name on the audio- recorder or the notes. Any information about you will have a number on it instead of your name. Only the researchers will know what your number is and we will lock that information up with a lock and key. It will not be shared with or given to anyone. The results of this study will be a part of a PhD thesis and it is possible to be published in science journals after completion of the research. If you decide to take part in the study you will not be identified in any report. If the write up of the results draws on a quotation from you which might identify you or your company, I will check with you before using it. The audio files and notes will be destroyed once they have been transcribed and the analysis completed. The transcripts and analysis records can then be kept for 10 years.

What are the possible disadvantages and risks to taking part?
There will be no significant disadvantages or risks to taking part. There is a risk that you may share some personal or confidential information by chance, or that you may feel uncomfortable talking about some of the topics. However, we do not wish for this to happen. You do not have to answer any question or take part in the discussion/interview/survey if you feel the question(s) are too personal or if talking about them makes you uncomfortable.

What are the possible benefits of taking part?
There will be no direct benefit to you, but your participation is likely to help water management of Tehran to have a new look to the city's water issues. You will be provided with a summary of my findings.

Will my taking part in this study be kept confidential?
Yes, all information that is collected about your understandings and views during the course of the research will be handled in confidence. We will not be sharing information about you to anyone outside of the research team. The information that we collect from this research project will be kept private. Any information about you will have a number on it instead of your name. Only the researchers will know what your number is and we will lock that information up with a lock and key. It will not be shared with or given to anyone.

What will happen to the results of the research study?
The results of this study will be a part of a PhD thesis and it is possible to be published in science journals after completion of the research. If you decide to take part in the study you will not be identified in any report.

Contact for Further Information
If you would like any further information please ask the researcher who is discussing this Information Sheet with you by contacting her email or mobile phone as follows:

Email: f.delavar@aol.com
Mobile: 09893615899

Part II: Consent Form

Participants:
I have read the Information Sheet, or it has been read to me. I have had the opportunity to ask questions about it and any questions I have been asked have been answered to my satisfaction. I consent voluntarily to be a participant in this study. I understand that:

- Taking part in the interview is my choice and that I can withdraw at any time before the data analysis begins.
- The researcher is ready to answer to the best her ability any questions related to the study.
- All data collected during the interview (notes, audio recordings) will be kept anonymous.
- My name and the name of my company (if applicable) will remain anonymous.
- I will not be subject to any influence, pressure or inducement.
- I am free to discontinue participation at any time before the data analysis begins and data collected from those interviews will not be considered for research and will be destroyed.
- The audio files and notes will be destroyed once they have been transcribed and the analysis completed. The transcripts and analysis records can then be kept for up to10 years.

Researcher:
I have correctly read out the Information Sheet to the potential participant, and to the best of my ability made sure that the participant understands that the following will be done:

- Taking part in the interview is completely up to your decision, and you are free to withdraw their consent at any time before the data analysis begins.
- The researcher will be ready to answer correctly and to the best her ability any questions related to the study to participate.
- All data collected during the interview (notes, audio recording) will be kept anonymous.
- Your name and the name of your company will remain anonymous.
- You will not be subject to any influence, pressure or inducement.
- You are free to discontinue participation at any time they wish and data collected from those interviews will not be considered for research and will be destroyed.
- The audio files and notes will be destroyed once they have been transcribed and the analysis completed. The transcripts and analysis records can then be kept for 10 years.

Print Name of Researcher/person taking the consent_____
Signature of Researcher /person taking the consent_____
Date _____
Day/month/year

Appendix C1

برگه رضایت شرکت درطرح تحقیقاتی(متخصصین آب)

این برگه شامل اطلاعات لازم برای متخصصین آب درکشورواستان تهران می باشد که دعوت به شرکت در موضوع تحقیقی در رابطه با مدیریت آب شرب شده اند.

نام محقق: فریده دلاوری عدالت

این برگه شامل اطلاعات مورد نیاز در مورد این پژوهش می باشد

یک سری کپی کامل از این برگه به شما داده خواهد شد

مقدمه:

این پژوهش توسط فریده دلاوری عدالت دانشجوی دکتری در زمینه مدیریت آبها در حال انجام می باشد. پژوهشگر بدینوسیله از شما دعوت می کند که بخشی از این تحقیق باشید. شما لازم نیست همین امروز تصمیم بگیرید که میخواهید در این تحقیق شرکت کنید یا نه، قبل از تصمیم گیری دراین باره مهم است که بدانید این تحقیق چیست و چرا درحال انجام است. لطفا موارد زیر را مطالعه بفرمایید، شما می توانید با هر کسی که احساس راحتی میکنید در مورد این پژوهش صحبت کنید. اگر موردی واضح نیست یا شما اطلاعات بیشتری می خواهید از پژوهشگر بخواهید برایتان توضیح دهد.

هدف از پژوهش:

کمبود مداوم منابع آب، نرخ رشد جمعیت به ویژه درشهرهای بزرگ وهمچنین تغییرات اقلیمی آب وهوایی، تاثیرات غیرقابل پیش بینی برمنابع آب خواهند داشت. مشکلات آب بسیار پیچیده است ومنافع اجتماعی، اقتصادی و زیست محیطی را در برمیگیرد. هدف ازاین مطالعه افزایش دانش دررابطه با مصرف و مدیریت آب شرب دراستان تهران است.مطالعه دراین مورد ممکن است به ما برای مدیریت بهترآب شرب کمک کند.

چرا شما انتخاب شده اید؟

از شما دعوت به شرکت دراین پژوهش شده زیرا که تجربه ودانش شما به عنوان یک متخصص در زمینه آب می تواند به درک مسائل و مدیریت آب شرب استان تهران کمک کند.

آیا شما باید دراین تحقیق مشارکت کنید؟

این شما هستید که تصمیم می گیرید که دراین تحقیق شرکت کنید یا نه. انتخاب شما تاثیری بر کار شما و یا بر روی هر ارزیابی و یا گزارش های مربوط به کار شما نخواهد داشت. اگرکه تصمیم به شرکت در این تحقیق را گرفتید این امکان برای شما وجود دارد که نظر خود را بدون ارائه دلیل تغییردهید و یا خواهان توقف شرکت در این تحقیق شوید.

با شرکت شما در این تحقیق چه اتفاقی خواهد افتاد؟

درصورتی که شما تصمیم به شرکت در این تحقیق را گرفتید، دریک مصاحبه با محقق در حدود ۱ تا ۱ساعت ونیم در محل کار شما یا محلی که برای شما مناسب باشد شرکت خواهید کرد. اگردرطول مصاحبه مایل نبودید به سوالی پاسخ دهید لطفا به محقق متذکرشوید تا سوال بعدی را مطرح کند. مصاحبه شامل پژوهشگر و شرکت کننده می باشد، حضور فرد یا افراد دیگر با توافق طرفین بالامانع میباشد. صدای مصاحبه ضبط خواهدشد، اما اگر شما دراین مورد احساس راحتی نمی کنید، از یادداشت برداری استفاده خواهد شد. اطلاعات حاصل ازمصاحبه محرمانه است و هیچ کس به جز محقق به اطلاعات مستند در مصاحبه دسترسی نخواهد داشت. تمام اطلاعات جمع آوری شده در طول مصاحبه (یادداشت ها، ضبط صدا) ناشناس نگه داشته خواهند شد. هر گونه اطلاعات در مورد شما با یک شماره بر روی آن به جای استفاده از نام

شما درمحلی امن نگهداری خواهد شد. اطلاعات مربوط به شما با کسی خارج از تیم تحقیقاتی به اشتراک گذاشته نخواهد شد.
نتایج حاصل از این مطالعه بخشی از یک پایان نامه دکتری است وممکن است درمجلات علمی پس از اتمام این تحقیق منتشر شود. اگرقسمتی ازنتایج تحقیقات باعث شناسایی شما و یا سازمان شما شود قبل ازاستفاده از آن از شما اجازه گرفته خواهد شد. فایل صوتی مصاحبه ویادداشت ها بعد اززرونویسی وتجزیه وتحلیل داده ها امحاء خواهد شد. متن ها و تجزیه و تحلیلها ممکن است به مدت ۰۱ سال نگه داشته شوند.

چه معایب و خطراتی در رابطه با شرکت در این تحقیق وجود دارد؟
خطری دررابطه با شرکت دراین تحقیق برای شما وجود نخواهد داشت. اما این احتمال وجود دارد که شما درمورد برخی ازموضوعات احساس خوبی نداشته باشید ومایل به صحبت کردن درباره آن موارد نباشید. شما هیچ اجباری برای پاسخ دادن به سوالاتی که صحبت کردن درمورد آنها باعث ناراحتی شما می شود ویا بیش ازحد شخصی هستند را ندارید.

منافع ممکن از شرکت در این تحقیق چه هستند؟
شرکت دراین تحقیق مزایای مستقیمی برای شما نخواهد داشت، اما شرکت شما کمک شایانی خواهد بود به مدیریت آب استان تهران برای نگرشی جدید به مسائل آب شهری.

آیا شرکت در این تحقیق محرمانه نگه داشته می شود؟
بله، تمام اطلاعات مربوط به شما دراین تحقیق محرمانه خواهد بود. اطلاعات درمورد شما با کس دیگری خارج از تیم تحقیقاتی به اشتراک گذاشته نخواهد شد.هرگونه اطلاعات مربوط به شما با یک عدد برروی آن به جای نام و نام خانوادگی ذخیره خواهد شد. تمام اطلاعات مربوط به مصاحبه شونده ها در جایی امن خواهد بود و تنها محقق این پروژه به آنها دسترسی خواهد داشت.

برای نتایج به دست آمده از پژوهش چه اتفاقی می افتد؟
نتایج این مطالعه بخشی از پایان نامه دکتری خواهد بود و ممکن است در مجلات علمی بعد از اتمام این تحقیق منتشر شود.

تماس برای کسب اطلاعات بیشتر:
اگراطلاعات بیشتری می خواهید ویا مایل به بحث درباره این برگه اطلاعاتی هستید لطفا ازمحقق سوال بفرمایید. از طریق تماس با ایمیل و یا تلفن همراه به شرح زیر:
پست الکترونیک edalat.farideh@yahoo.com :
همراه: 09361589905

پژوهشگر:

برگه اطلاعاتی به طور کامل به شرک کننده بالقوه این پژوهش ارایه گردید. پژوهشگر به بهترین توانایی اش اطمینان حاصل نمود که شرکت کننده دراین مصاحبه موارد به شرح زیر را میداند:

- *شرکت دراین مصاحبه کاملا اختیاری است و شرکت کننده بالقوه آزاد خواهد بود که از شرکت دراین پژوهش امتناع نماید. شرکت کننده می تواند هرزمان قبل ازاین که تجزیه و تحلیل داده ها آغاز شود ازپژوهش خارج شود. دراین صورت داده های جمع آوری شده ازاین مصاحبه برای تحقیق در نظرگرفته نشده و نابود خواهد شد.*
- *پژوهشگر به بهترین توانایی خود برای پاسخ دادن به هرگونه سؤال شرکت کننده دررابطه با پژوهش آماده خواهد بود.*
- *همه داده های جمع آوری شده در طول مصاحبه (یادداشت ها، ضبط صدا) ناشناس خواهد ماند.*
- *نام شرکت کننده و نام سازمان ناشناس باقی خواهد ماند.*
- *اگرقسمتی از نتایج تحقیقات باعث شناسایی شما و یا شرکت شما شود قبل ازاستفاده ازآن ازشما اجازه گرفته خواهد شد.*
- شرکت کننده دراین پروژه تحت هیچ گونه نفوذ و فشاری نخواهد بود.
- فایل صوتی مصاحبه و یادداشت ها بعد از رونویسی و تجزیه و تحلیل داده ها نابود خواهد شد. متن ها و تجزیه و تحلیلها ممکن است به مدت ۰۱ سال نگه داشته شوند.

نام و نام خانوادگی پژوهشگر _____

امضای پژوهشگر _____

تاریخ _____

Appendix D

Informed Consent Form for water consumers

This Informed Consent Form is for water consumers living in Tehran province who we are inviting to participate in our research subject of Water Management.

Name of Investigator: Farideh Delavari-Edalat

This Informed Consent Form has two parts:

- **Information Sheet**
- **Consent Form**

You will be given a copy of the full Informed Consent Form

Part I: Information Sheet

Introduction
I am a PhD student and I am doing research on the water management in Tehran. I am going to give you information and invite you to be part of this research. You do not have to decide today whether or not you will participate in the research. Before you decide, it is important for you to understand why the research is being done and what it will involve. Please read the following, you can talk to anyone you feel comfortable with about the research. Ask me if there is anything that is not clear or if you would like more information. Take your time to decide whether or not you wish to take part in this study.

Purpose of the research
With continued water resource shortages and population growth rate especially in the big cities along with climate change and its effect on the water resources there will be more unpredictable behaviour in water sectors. Water problems are very complex and they involve different values including social, economic and environmental interests. The purpose of this study is to learn how people in Tehran manage, use and value water. The study wants to know more about water policies because this knowledge may be able to help us for a better water management.

Why have I been chosen?
You are being invited to take part in this research because we feel that you as a water consumer can contribute to our understanding and knowledge of Tehran water issues.

Do I have to take part?
It is up to you to decide whether or not to take part. The choice that you make will have no bearing on your job or on any work-related evaluations or reports. You may change your mind later and stop participating even if you agreed earlier without giving a reason.

What will happen to me if I take part?
If you decide to take part, you will participate in an interview with myself. This will take around 45 minutes to 1 hour. During the interview, I will sit down with you in a comfortable place in your local community or some other place. If you do not wish to answer any of the questions during the interview, you may say so and the interviewer will move on to the next question. No one else but the interviewer will be present unless you would like someone

else to be there. The information recorded is confidential, and no one else will access to the information documented during your interview. The interview will be audio-recorded but if you feel uncomfortable about using the recorder, taking notes will be used. No-one will be identified by name on the audio- recorder or the notes. All data collected during the interview (notes, audio recording) will be kept anonymous. Your name and the name of your company will remain anonymous. You will not be identified by name on the audio-recorder or the notes. Any information about you will have a number on it instead of your name. Only the researchers will know what your number is and we will lock that information up with a lock and key. It will not be shared with or given to anyone. The results of this study will be a part of a PhD thesis and it is possible to be published in science journals after completion of the research. If you decide to take part in the study you will not be identified in any report. If the write up of the results draws on a quotation from you which might identify you or your company, I will check with you before using it. The audio files and notes will be destroyed once they have been transcribed and the analysis completed. The transcripts and analysis records can then be kept for 10 years.

What are the possible disadvantages and risks to taking part?
There will be no disadvantages or risks to taking part. There is a risk that you may share some personal or confidential information by chance, or that you may feel uncomfortable talking about some of the topics. However, we do not wish for this to happen. You do not have to answer any question or take part in the discussion/interview/survey if you feel the question(s) are too personal or if talking about them makes you uncomfortable.

What are the possible benefits of taking part?
There will be no direct benefit to you, but your participation is likely to help water management of Tehran to have a new look to the city's water issues.

Will my taking part in this study be kept confidential?
Yes, all information that is collected about you during the course of the research will be handled in confidence. We will not be sharing information about you to anyone outside of the research team. The information that we collect from this research project will be kept private. Any information about you will have a number on it instead of your name. Only the researchers will know what your number is and we will lock that information up with a lock and key. It will not be shared with or given to anyone.

What will happen to the results of the research study?
The results of this study will be a part of a PhD thesis and it is possible to be published in science journals after completion of the research. If you decide to take part in the study you will not be identified in any report.

Contact for Further Information
If you would like any further information please ask the researcher who is discussing this Information Sheet with you by contacting her email or mobile phone as follows:

Email: f.delavar.aol.com

Mobile: 09893615899

Part II: Consent Form

Participants:

I have read the above information, or it has been read to me. I have had the opportunity to ask questions about it and any questions I have been asked have been answered to my satisfaction. I consent voluntarily to be a participant in this study. I understand that:

- Taking part in the interview is my choice and that I can withdraw at any time before the data analysis begins.
- The researcher is ready to answer to the best her ability any questions related to the study.
- All data collected during the interview (notes, audio recordings) will be kept anonymous.
- My name will remain anonymous.
- I will not be subject to any influence, pressure or inducement.
- I am free to discontinue participation at any time before the data analysis begins data collected from those interviews will not be considered for research and will be destroyed.
- The audio files and notes will be destroyed once they have been transcribed and the analysis completed. The transcripts and
- analysis records can then be kept for up to10 years.

Researcher:

I have correctly read out the Information Sheet to the potential participant, and to the best of my ability made sure that the participant understands that the following will be done:

- Taking part in the interview is completely up to your decision, and you are free to withdraw their consent at any time before the data analysis begins.
- The researcher will be ready to answer correctly and to the best her ability any questions related to the study to participate.
- All data collected during the interview (notes, audio recording) will be kept anonymous.
- Your name and the name of your company will remain anonymous.
- You will not be subject to any influence, pressure or inducement.
- You are free to discontinue participation at any time they wish and data collected from those interviews will not be considered for research and will be destroyed.
- The audio files and notes will be destroyed once they have been transcribed and the analysis completed. The transcripts and analysis records can then be kept for 10 years.

Print Name of Researcher/person taking the consent_____

Signature of Researcher /person taking the consent_____

Date _____

Day/month/year

Appendix D1

برگه رضایت شرکت درطرح تحقیقاتی
مصرف کنندگان آب

این برگه شامل اطلاعات لازم برای مصرف کنندگان آب استان تهران است که دعوت به شرکت در موضوع تحقیقی در رابطه با مدیریت آب شرب شده اند.

نام محقق: فریده دلاوری عدالت

این برگه شامل اطلاعات مورد نیاز در مورد این پژوهش می باشد

یک سری کپی کامل از این برگه به شما داده خواهد شد

اطلاعات مورد نیاز در مورد این پژوهش

مقدمه:
این پژوهش توسط فریده دلاوری عدالت دانشجوی دکتری در زمینه مدیریت آبها در حال انجام می باشد. پژوهشگر بدینوسیله از شما دعوت می کند که بخشی از این تحقیق باشید. شما لازم نیست همین امروز تصمیم بگیرید که میخواهید در این تحقیق شرکت کنید یا نه، قبل از تصمیم گیری دراین باره مهم است که بدانید این تحقیق چیست و چرا درحال انجام است. لطفا موارد زیر را مطالعه بفرمایید، شما می توانید با هر کسی که احساس راحتی میکنید در مورد این پژوهش صحبت کنید. اگر موردی واضح نیست یا شما اطلاعات بیشتری می خواهید از پژوهشگر بخواهید برایتان توضیح دهد.

هدف از پژوهش:
کمبود مداوم منابع آب، نرخ رشد جمعیت به ویژه درشهرهای بزرگ و همچنین تغییرات اقلیمی آب وهوایی تاثیرات غیرقابل پیش بینی برمنابع آب خواهند داشت. مشکلات آب بسیار پیچیده است ومنافع اجتماعی، اقتصادی و زیست محیطی را در برمیگیرد. هدف ازاین مطالعه افزایش دانش دررابطه با مصرف و مدیریت آب شرب دراستان تهران است. مطالعه دراین مورد ممکن است به ما برای مدیریت بهترآب شرب کمک کند.

چرا شما انتخاب شده اید؟
از شما دعوت به شرکت دراین پژوهش شده چون که ما احساس می کنیم که شما به عنوان یک مصرف کننده آب می توانید به درک و دانش ما از مسائل آب شرب استان تهران کمک کنید.

آیا شما باید در این تحقیق مشارکت کنید؟
این شما هستید که تصمیم می گیرید که دراین تحقیق شرکت کنید یا نه، این امکان برای شما وجود دارد که نظر خود را بدون ارائه دلیل تغییر دهید وخواهان توقف شرکت در این تحقیق شوید.

با شرکت شما در این تحقیق چه اتفاقی خواهد افتاد؟
درصورتی که شما تصمیم به شرکت دراین تحقیق را گرفتید، دریک مصاحبه با محقق درحدود ۴۵ دقیقه تا ۱ ساعت درمحلی که برای شما مناسب باشد شرکت خواهید کرد.

اگردرطول مصاحبه مایل نبودید به سوالی پاسخ دهید لطفا به محقق متذکرشوید تا سوال بعدی را مطرح کند. مصاحبه شامل پژوهشگر و شرکت کننده می باشد، حضور فرد یا افراد دیگر با توافق طرفین بالامانع میباشد. صدای مصاحبه ضبط خواهدشد، اما اگر شما دراین مورد احساس راحتی نمی کنید، از یادداشت برداری استفاده خواهد شد. اطلاعات حاصل ازمصاحبه محرمانه است و هیچ کس به جز محقق به اطلاعات مستند در مصاحبه دسترسی نخواهد داشت. تمام اطلاعات جمع آوری شده در طول مصاحبه (یادداشت ها، ضبط صدا) ناشناس نگه داشته خواهند شد. نام شما و نام سازمان شما ناشناس باقی خواهد ماند. هر گونه اطلاعات در مورد شما با یک شماره بر روی آن به جای استفاده از نام شما درمحلی امن نگهداری خواهد شد. اطلاعات مربوط به شما با کسی خارج از تیم تحقیقاتی به اشتراک گذاشته نخواهد شد.
نتایج حاصل از این مطالعه بخشی از یک پایان نامه دکتری است وممکن است درمجلات علمی پس از اتمام این تحقیق منتشر شود. اگرقسمتی ازنتایج تحقیقات باعث شناسایی شما و یا سازمان شما شود قبل ازاستفاده از آن از شما اجازه گرفته خواهد شد. فایل صوتی مصاحبه ویادداشت ها بعد ازرونویسی وتجزیه وتحلیل داده ها نابود خواهد شد. متن ها و تجزیه و تحلیلها ممکن است به مدت ۰۱ سال نگه داشته شوند.

چه معایب و خطراتی در رابطه با شرکت در این تحقیق وجود دارد؟
خطری دررابطه با شرکت دراین تحقیق برای شما وجود نخواهد داشت. اما این احتمال وجود دارد که شما درمورد برخی ازموضوعات احساس خوبی نداشته باشید ومایل به صحبت کردن درباره آن موارد نباشید. شما هیچ اجباری برای پاسخ دادن به سوالاتی که صحبت کردن درمورد آنها باعث ناراحتی شما می شود ویا بیش ازحد شخصی هستند را ندارید.

منافع ممکن از شرکت در این تحقیق چه هستند؟
شرکت دراین تحقیق مزایای مستقیمی برای شما نخواهد داشت، اما شرکت شما کمک شایانی خواهد بود به مدیریت آب استان تهران برای نگرشی جدید به مسائل آب شهری.

آیا شرکت در این تحقیق محرمانه نگه داشته می شود؟
بله، تمام اطلاعات مربوط به شما دراین تحقیق محرمانه خواهد بود. اطلاعات درمورد شما با کس دیگری خارج از تیم تحقیقاتی به اشتراک گذاشته نخواهد شد.هرگونه اطلاعات مربوط به شما با یک عدد برروی آن به جای نام و نام خانوادگی ذخیره خواهد شد. تمام اطلاعات مربوط به مصاحبه شونده ها در جایی امن خواهد بود و تنها محقق این پروژه به آنها دسترسی خواهد داشت.

برای نتایج به دست آمده از پژوهش چه اتفاقی می افتد؟
نتایج این مطالعه بخشی از پایان نامه دکتری خواهد بود و ممکن است در مجلات علمی بعد از اتمام این تحقیق منتشر شود.

تماس برای کسب اطلاعات بیشتر:
اگراطلاعات بیشتری می خواهید ویا مایل به بحث درباره این برگه اطلاعاتی هستید لطفا ازمحقق سوال بفرمایید. از طریق تماس با ایمیل و یا تلفن همراه به شرح زیر:

پست الکترونیک:
edalat.farideh@yahoo.com
همراه :09361589905

پژوهشگر:

برگه اطلاعاتی به طور کامل به شرک کننده بالقوه این پژوهش ارایه گردید. پژوهشگر به بهترین توانایی اش اطمینان حاصل نمود که شرکت کننده دراین مصاحبه موارد به شرح زیر را میداند:

- *شرکت دراین مصاحبه کاملا اختیاری است و شرکت کننده بالقوه آزاد خواهد بود که از شرکت دراین پژوهش امتناع نماید. شرکت کننده می تواند هرزمان قبل ازاین که تجزیه و تحلیل داده ها آغاز شود ازپژوهش خارج شود. دراین صورت داده های جمع آوری شده ازاین مصاحبه برای تحقیق در نظرگرفته نشده و نابود خواهد شد.*
- *پژوهشگر به بهترین توانایی خود برای پاسخ دادن به هرگونه سؤال شرکت کننده دررابطه با پژوهش آماده خواهد بود.*
- *همه داده های جمع آوری شده در طول مصاحبه (یادداشت ها، ضبط صدا) ناشناس خواهد ماند.*
- *نام شرکت کننده و نام سازمان ناشناس باقی خواهد ماند.*
- *اگرقسمتی از نتایج تحقیقات باعث شناسایی شما و یا شرکت شما شود قبل ازاستفاده ازآن ازشما اجازه گرفته خواهد شد.*
- شرکت کننده دراین پروژه تحت هیچ گونه نفوذ و فشاری نخواهد بود.
- فایل صوتی مصاحبه و یادداشت ها بعد از رونویسی و تجزیه و تحلیل داده ها نابود خواهد شد. متن ها و تجزیه و تحلیلها ممکن است به مدت ۰۱ سال نگه داشته شوند.

نام و نام خانوادگی پژوهشگر _____

امضای پژوهشگر _____

تاریخ _____